Historic Preservation Services
Community Development & Neighborhood Services
281 North College Avenue
P.O. Box 580
Fort Collins, CO 80522.0580

970.416.4250
preservation@fcgov.com
fcgov.com/historicpreservation

CERTIFICATE OF APPROPRIATENESS
ISSUED: November 9, 2021
EXPIRATION: November 9, 2022

Janice Devore
1617 Sheely Dr.
Fort Collins, CO 80526

Dear Property Owner:

This letter provides you with confirmation that the proposed changes to your designated Fort Collins landmark property, the McCluskey House at 1617 Sheely Drive have been approved by the City's Historic Preservation Division because the proposed work meets the criteria and standards in Chapter 14, Article IV of the Fort Collins Municipal Code.

1) Rooftop solar installation on rear (southwest-facing) roof.

Notice of the approved application has been provided to building and zoning staff to facilitate the processing of any permits that are needed for the work.

Please note that all ensuing work must conform to the approved plans. Any non-conforming alterations are subject to stop-work orders, denial of Certificate of Occupancy, and restoration requirements and penalties.

If the approved work is not completed prior to the expiration date noted above, you may apply for an extension by contacting staff at least 30 days prior to expiration. Extensions may be granted for up to 12 additional months, based on a satisfactory staff review of the extension request.

Property owners can appeal staff design review decisions by filing a written notice of appeal to the Director of Community Development & Neighborhood Services within fourteen (14) days of this decision. If you have any questions regarding this approval, or if I may be of any assistance, please do not hesitate to contact me. I may be reached at jbertolini@fcgov.com, or 970-416-4250.

Sincerely,

Jim Bertolini
Historic Preservation Planner

Applicable Code Standard	Summary of Code Requirement and Analysis (Rehabilitation)	Standard Met (Y/N)
SOI #1	*A property will be used as it was historically or be given a new use that requires minimal change to its distinctive materials, features, spaces, and spatial relationships;* **The house will remain in residential use.**	**Y**
SOI #2	*The historic character of a property will be retained and preserved. The removal of distinctive materials or alteration of features, spaces, and spatial relationships that characterize a property will be avoided.*	**N/A**
SOI #3	*Each property will be recognized as a physical record of its time, place, and use. Changes that create a false sense of historical development, such as adding conjectural features or elements from other historic properties, will not be undertaken.* **The solar panels are clearly distinguished as new technology that post-dates the historic period of the Sheely Drive Landmark District.**	**Y**
SOI #4	*Changes to a property that have acquired historic significance in their own right will be retained and preserved.*	**N/A**
SOI #5	*Distinctive materials, features, finishes, and construction techniques or examples of craftsmanship that characterize a property will be preserved.*	**N/A**
SOI #6	*Deteriorated historic features will be repaired rather than replaced. Where the severity of deterioration requires replacement of a distinctive feature, the new feature will match the old in design, color, texture, and, where possible, materials. Replacement of missing features will be substantiated by documentary and physical evidence.*	**N/A**
SOI #7	*Chemical or physical treatments, if appropriate, will be undertaken using the gentlest means possible. Treatments that cause damage to historic materials will not be used.*	**N/A**
SOI #8	*Archeological resources will be protected and preserved in place. If such resources must be disturbed, mitigation measures will be undertaken.*	**N/A**

SOI #9	*New additions, exterior alterations, or related new construction shall not destroy historic materials that characterize the property. The new work shall be differentiated from the old and shall be compatible with the massing, size, scale, and architectural features to protect the historic integrity of the property and its environment.* **The solar panels will be flush-mounted and located on the rear (southwest-facing) slope of the building. They will have little to no visibility from the public right-of-way and are not disrupting the historic, low-slung gabled roof shape and massing of the historic Ranch-style building.**	**Y**
SOI #10	*New additions and adjacent or related new construction will be undertaken in such a manner that, if removed in the future, the essential form and integrity of the historic property and its environment would be unimpaired.* **Rooftop solar installations are typically reversible with no loss of historic material or features, and this appears to be the case here.**	**Y**

VSE Project Number: U2001.2556.211

October 28, 2021

Blue Raven Solar, LLC
ATTENTION: Carson Grover
1220 S. 630 E., Suite 430
American Fork, UT 84003

REFERENCE: Janice Devore Residence: 1617 Sheely Drive, Fort Collins, CO 80526
Blue Raven Solar, LLC Project: 372602
Solar Array Installation

To Whom It May Concern:

Per your request, we have reviewed the existing structure at the above referenced site. The purpose of our review was to determine the adequacy of the existing structure to support the proposed installation of solar panels on the roof as shown on the panel layout plan.

Based upon our review, we conclude that the existing structure is adequate to support the proposed solar panel installation.

Design Parameters

Code: International Building Code, 2018 Edition
Risk Category: II
Design wind speed, Vult: 140 mph (3-sec gust) per ASCE 7-16
Wind exposure category: C
Ground snow load, Pg: 30 psf
Minimum roof snow load, Pm: 30 psf (not reducible)

Existing Roof Structure

Roof structure: 2x8 rafters @ 24" o.c. (Not Vaulted) & 4x8 rafters @ 48" o.c. (Vaulted)
Roofing material: composite shingles
Roof pitch: 11:12

Connection to Roof

Mounting connection: (1) 5/16" lag screw w/ min. 2.5" threaded embedment into framing at max. 48" o.c. along rails (2) rails per row of panels, evenly spaced; panel length perpendicular to the rails not to exceed 40 in. Rail cantilever shall not exceed 50% of connection spacing.

Conclusions

Based upon our review, we conclude that the existing structure is adequate to support the proposed solar panel installation. The gravity loads, and thus the stresses of the structural elements, in the area of the solar array are either decreased or increased by no more than 5%. Therefore, the requirements of Section 806.2 of the 2018 IEBC are met and the structure is permitted to remain unaltered.

The solar array will be flush-mounted (no more than 10" above the roof surface) and parallel to the roof surface. Thus, we conclude that any additional wind loading on the structure related to the addition of the proposed solar array is negligible. The attached calculations verify the capacity of the connections of the solar array to the existing roof against wind (uplift), the governing load case. Because the increase in lateral forces is less than 10%, this addition meets the requirements of the exception in Section 806.3 of the 2018 IEBC. Thus the existing lateral force resisting system is permitted to remain unaltered.

Limitations

Installation of the solar panels must be performed in accordance with manufacturer recommendations. All work performed must be in accordance with accepted industry-wide methods and applicable safety standards. The contractor must notify Vector Structural Engineering, LLC should any damage, deterioration or discrepancies between the as-built condition of the structure and the condition described in this letter be found. Connections to existing roof framing must be staggered, except at array ends, so as not to overload any existing structural member. The use of solar panel support span tables provided by others is allowed only where the building type, site conditions, site-specific design parameters, and solar panel configuration match the description of the span tables. The design of the solar panel racking (mounts, rails, etc.) and electrical engineering is the responsibility of others. Waterproofing around the roof penetrations is the responsibility of others. Vector Structural Engineering assumes no responsibility for improper installation of the solar array.

VECTOR STRUCTURAL ENGINEERING, LLC

10/28/2021

Eric Sumsion, P.E.
CO License: 56167 - Expires: 10/31/2021
Project Engineer

Enclosures

ESS/wrm

JOB NO.: U2001.2556.211
SUBJECT: WIND PRESSURE
Not Vaulted

PROJECT: Janice Devore Residence

Components and Cladding Wind Calculations

Label: Solar Panel Array Note: Calculations per ASCE 7-16

SITE-SPECIFIC WIND PARAMETERS:

Basic Wind Speed [mph]:	140
Exposure Category:	C
Risk Category:	II

Notes:

ADDITIONAL INPUT & CALCULATIONS:

Height of Roof, h [ft]:	15	(Approximate)			
Comp/Cladding Location:	Gable Roofs 27° < θ ≤ 45°				
Enclosure Classification:	Enclosed Buildings				
Zone 1, 2e, 2r GCp:	1.80	Figure 30.3-2D (negative coeff.)	Zone 1, 2e, 2r γ_a:	0.80	Fig. 29.4-8
Zone 2n, 3r GCp:	2.00		Zone 2n, 3r γ_a:	0.80	
Zone 3e GCp:	2.67		Zone 3e γ_a:	0.80	

α:	9.5	Table 26.11-1
z_g [ft]:	900	Table 26.11-1
K_h:	0.85	Table 26.10-1
K_e:	0.83	Table 26.9-1
K_{zt}:	1	Equation 26.8-1
K_d:	0.85	Table 26.6-1
Velocity Pressure, q_h [psf]:	30.2	Equation 26.10-1
γ_E:	1.50	Section 29.4.4

WIND PRESSURES:

Equation 29.4-7 $p = q_h(GC_p)(\gamma_E)(\gamma_a)$

Zone 1, 2e, 2r, p [psf]:	65.2	psf (1.0 W)
Zone 2n, 3r, p [psf]:	72.4	psf (1.0 W)
Zone 3e, p [psf]:	96.7	psf (1.0 W)

(a = 3 ft)

JOB NO.: U2001.2556.211
SUBJECT: WIND PRESSURE
Vaulted

PROJECT: Janice Devore Residence

Components and Cladding Wind Calculations

Label: Solar Panel Array

Note: Calculations per ASCE 7-16

SITE-SPECIFIC WIND PARAMETERS:

Basic Wind Speed [mph]:	140
Exposure Category:	C
Risk Category:	II

Notes:

ADDITIONAL INPUT & CALCULATIONS:

Height of Roof, h [ft]:	15	(Approximate)			
Comp/Cladding Location:	Gable Roofs 27° < θ ≤ 45°				
Enclosure Classification:	Enclosed Buildings				
Zone 1, 2e, 2r GCp:	1.68	Figure 30.3-2D (negative coeff.)	Zone 1, 2e, 2r γ_a:	0.75	Fig. 29.4-8
Zone 2n, 3r GCp:	2.00		Zone 2n, 3r γ_a:	0.80	
Zone 3e GCp:	2.67		Zone 3e γ_a:	0.80	

α:	9.5	Table 26.11-1
z_g [ft]:	900	Table 26.11-1
K_h:	0.85	Table 26.10-1
K_e:	0.83	Table 26.9-1
K_{zt}:	1	Equation 26.8-1
K_d:	0.85	Table 26.6-1
Velocity Pressure, q_h [psf]:	30.2	Equation 26.10-1
γ_E:	1.50	Section 29.4.4

WIND PRESSURES:

Equation 29.4-7 $p = q_h(GC_p)(\gamma_E)(\gamma_a)$

Zone 1, 2e, 2r, p [psf]:	56.8	psf (1.0 W)
Zone 2n, 3r, p [psf]:	72.4	psf (1.0 W)
Zone 3e, p [psf]:	96.7	psf (1.0 W)

(a = 3 ft)

JOB NO.: U2001.2556.211
SUBJECT: CONNECTION
Not Vaulted

PROJECT: Janice Devore Residence

Calculate Uplift Forces on Connection

	Pressure (0.6 Dead -0.6 Wind) (psf)	Max Trib. Width[1] (ft)	Max Trib. Area[2] (ft^2)	Max Uplift Force (lbs)
Zone 1, 2e, 2r	37.3	4.0	6.7	249
Zone 2n, 3r	41.7	4.0	6.7	278
Zone 3e	56.2	4.0	6.7	375

Calculate Connection Capacity

Lag Screw Size [in]:	5/16	
C_d:	1.6	NDS Table 2.3.2
Embedment[3] [in]:	2.5	
Grade:	SPF (G = 0.42)	
Nominal Capacity [lbs/in]:	205	NDS Table 12.2A
Number of Screws:	1	
Prying Coefficient:	1.4	
Total Capacity [lbs]:	586	

Determine Result

Maximum Demand [lbs]:	375
Lag Screw Capacity [lbs]:	586

Result: **Capacity > Demand, Connection is adequate.**

Notes

1. 'Max Trib. Width' is the width along the rails tributary to the connection.
2. 'Max Trib Area' is the product of the 'Max. Trib Width' and 1/2 the panel width/height perpendicular to the rails. (2) rails per row of panels. Length of panels perpendicular to the rails shall not exceed 40".
3. Embedment is measured from the top of the framing member to the beginning of the tapered tip of the lag screw. Embedment in sheathing or other material is not effective. The length of the tapered tip is not part of the embedment length.

JOB NO.: U2001.2556.211
SUBJECT: CONNECTION
Vaulted

PROJECT: Janice Devore Residence

Calculate Uplift Forces on Connection

	Pressure (0.6 Dead -0.6 Wind) (psf)	Max Trib. Width[1] (ft)	Max Trib. Area[2] (ft^2)	Max Uplift Force (lbs)
Zone 1, 2e, 2r	32.3	4.0	13.3	431
Zone 2n, 3r	41.7	4.0	6.7	278
Zone 3e	56.2	4.0	6.7	375

Calculate Connection Capacity

Lag Screw Size [in]:	5/16	
C_d:	1.6	NDS Table 2.3.2
Embedment[3] [in]:	2.5	
Grade:	SPF (G = 0.42)	
Nominal Capacity [lbs/in]:	205	NDS Table 12.2A
Number of Screws:	1	
Prying Coefficient:	1.4	
Total Capacity [lbs]:	586	

Determine Result

Maximum Demand [lbs]:	431
Lag Screw Capacity [lbs]:	586

Result: **Capacity > Demand, Connection is adequate.**

Notes

1. 'Max Trib. Width' is the width along the panel seams tributary to the connection.
2. 'Max Trib Area' is the product of the 'Max. Trib Width' and the panel width/height perpendicular to the direction of the connection spacing. Tributary area on connections at array edges are reduced by 50% as they
3. Embedment is measured from the top of the framing member to the beginning of the tapered tip of the lag screw. Embedment in sheathing or other material is not effective. The length of the tapered tip is not part of the embedment length.

JOB NO.: U2001.2556.211
SUBJECT: GRAVITY LOADS

PROJECT: Janice Devore Residence

GRAVITY LOADS

Roof Pitch: 11.0 :12

ROOF DEAD LOAD (D)	Design material weight [psf]	Increase due to pitch	Material weight [psf]
Composite Shingles	2.7	1.36	2.0
1/2" Plywood	1.4	1.36	1.0
Framing	3.0		3.0
Insulation	0.0		0.0
1/2" Gypsum Clg.	0.0	1.36	0.0
M, E & Misc	0.0		0.0
Total Existing Roof DL	7.1		
PV Array DL	4.1	1.36	3

ROOF LIVE LOAD (Lr)

Existing Design Roof Live Load [psf]	20	ASCE 7-16 Table 4.3-1
Roof Live Load With PV Array [psf]	0	2018 IBC, Section 1607.13.5

SNOW LOAD (S):	Existing	w/ Solar Array	
Roof Slope [x:12]:	11.0	11.0	
Roof Slope [°]:	43	43	
Ground Snow Load, p_g [psf]:	30	30	ASCE 7-16, Section 7.2
Terrain Category:	C	C	ASCE 7-16, Table 7.3-1
Exposure of Roof:	Fully Exposed	Fully Exposed	ASCE 7-16, Table 7.3-1
Exposure Factor, C_e:	0.9	0.9	ASCE 7-16, Table 7.3-1
Thermal Factor, C_t:	1.1	1.1	ASCE 7-16, Table 7.3-2
Risk Category:	II	II	ASCE 7-16, Table 1.5-1
Importance Factor, I_s:	1.0	1.0	ASCE 7-16, Table 1.5-2
Flat Roof Snow Load, p_f [psf]:	21	21	ASCE 7-16, Equation 7.3-1
Minimum Roof Snow Load, p_m [psf]:	30	30	ASCE 7-16, Section 7.3.4
Unobstructed Slippery Surface?	No	Yes	ASCE 7-16, Section 7.4
Slope Factor Figure:	Figure 7-2b	Figure 7-2b	ASCE 7-16, Section 7.4
Roof Slope Factor, C_s:	0.85	0.46	ASCE 7-16, Figure 7.4-1
Sloped Roof Snow Load, p_s [psf]:	18	10	ASCE 7-16, Equation 7.4-1
Design Snow Load, S [psf]:	30	30	

JOB NO.: U2001.2556.211
SUBJECT: LOAD COMPARISON
Not Vaulted

PROJECT: Janice Devore Residence

Summary of Loads

	Existing	With PV Array
D [psf]	7	11
Lr [psf]	20	0
S [psf]	30	30

Maximum Gravity Loads:

	Existing	With PV Array	
(D + Lr) / Cd [psf]	22	12	ASCE 7-16, Section 2.4.1
(D + S) / Cd [psf]	32	36	ASCE 7-16, Section 2.4.1

(Cd = Load Duration Factor = 0.9 for D, 1.15 for S, and 1.25 for Lr)

Maximum Gravity Load [psf]:	32	36

Maximum Member Forces:

GEOMETRY

Span(ft)	12.6	(Approximate)
Solar Panel Array Start, a (ft)	0.0	(Approximate)
Solar Panel Array Length, b (ft)	4.9	(Approximate)
Framing Spacing (ft)	2.0	

MEMBER FORCES

	Shear Capacity	Shear Demand	Ratio	
Vertical Reaction, V_1 (lbs)	979	433	**44%**	**OK**
Vertical Reaction, V_2 (lbs)	979	412	**42%**	**OK**
	Existing	With PV Array	Ratio	
Moment @ Center, M (lbs-ft)	1275	1317	**103%**	**OK**

The gravity loads, and thus the stresses of the structural elements, in the area of the solar array are either decreased or increased by no more than 5%. Therefore, the requirements of Section 806.2 of the 2018 IEBC are met and the structure is permitted to remain unaltered.

JOB NO.: U2001.2556.211
SUBJECT: LOAD COMPARISON
Vaulted

PROJECT: Janice Devore Residence

Summary of Loads

	Existing	With PV Array
D [psf]	12	16
Lr [psf]	20	0
S [psf]	30	30

Maximum Gravity Loads:

	Existing	With PV Array	
(D + Lr) / Cd [psf]	26	18	ASCE 7-16, Section 2.4.1
(D + S) / Cd [psf]	36	40	ASCE 7-16, Section 2.4.1

(Cd = Load Duration Factor = 0.9 for D, 1.15 for S, and 1.25 for Lr)

Maximum Gravity Load [psf]:	36	40

Maximum Member Forces:

GEOMETRY

Span(ft)	12.6	(Approximate)
Solar Panel Array Start, a (ft)	0.0	(Approximate)
Solar Panel Array Length, b (ft)	4.9	(Approximate)
Framing Spacing (ft)	4.0	

MEMBER FORCES

	Shear Capacity	Shear Demand	Ratio	
Vertical Reaction, V_1 (lbs)	2284	974	**43%**	**OK**
Vertical Reaction, V_2 (lbs)	2284	931	**41%**	**OK**
	Existing	With PV Array	Ratio	
Moment @ Center, M (lbs-ft)	2885	2971	**103%**	**OK**

The gravity loads, and thus the stresses of the structural elements, in the area of the solar array are either decreased or increased by no more than 5%. Therefore, the requirements of Section 806.2 of the 2018 IEBC are met and the structure is permitted to remain unaltered.

GENERAL NOTES

CODE AND STANDARDS

1. ALL WORK SHALL COMPLY WITH 2020 NATIONAL ELECTRIC CODE (NEC), 2018 INTERNATIONAL BUILDING CODE (IBC), 2018 INTERNATIONAL RESIDENTIAL CODE (IRC), 2018 INTERNATIONAL PLUMBING CODE (IPC), AND ALL STATE AND LOCAL BUILDING, ELECTRICAL, AND PLUMBING CODES.
2. DRAWINGS HAVE BEEN DETAILED ACCORDING TO UL LISTING REQUIREMENTS.

SITE NOTES / OSHA REGULATION

1. A LADDER SHALL BE IN PLACE FOR INSPECTION IN COMPLIANCE WITH OSHA REGULATIONS.
2. THE PV MODULES ARE CONSIDERED NON-COMBUSTIBLE AND THIS SYSTEM IS A UTILITY INTERACTIVE SYSTEM.
3. THE SOLAR PV INSTALLATION SHALL NOT OBSTRUCT ANY PLUMBING, MECHANICAL, OR BUILDING ROOF VENTS.
4. ROOF COVERINGS SHALL BE DESIGNED, INSTALLED, AND MAINTAINED IN ACCORDANCE WITH THIS CODE AND THE APPROVED MANUFACTURER'S INSTRUCTIONS SUCH THAT THE ROOF COVERING SHALL SERVE TO PROTECT THE BUILDING OR STRUCTURE.
5.NO. OF SHINGLE LAYERS : 1

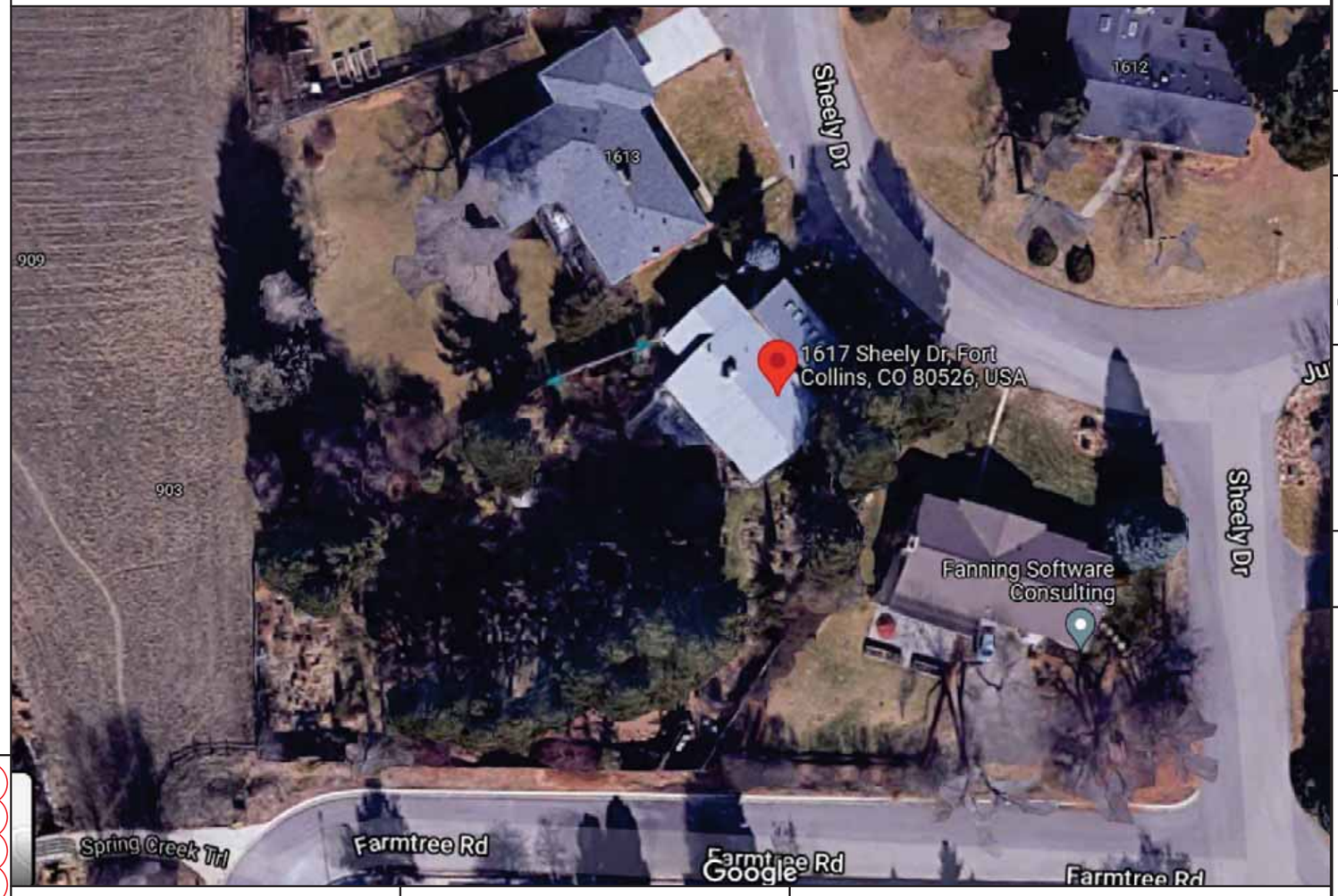
SOLAR CONTRACTOR

1. MODULE CERTIFICATIONS WILL INCLUDE UL1703, IEC61646, IEC61730.
2. IF APPLICABLE, MODULE GROUNDING LUGS MUST BE INSTALLED AT THE MARKED GROUNDING LUG HOLES PER THE MANUFACTURER'S INSTALLATION REQUIREMENTS.
3. AS INDICATED BY DESIGN, OTHER NRTL LISTED MODULE GROUNDING DEVICES MAY BE USED IN PLACE OF STANDARD GROUNDING LUGS AS SHOWN IN MANUFACTURER DOCUMENTATION AND APPROVED BY THE AHJ.
4. CONDUIT AND WIRE SPECIFICATIONS ARE BASED ON MINIMUM CODE REQUIREMENTS AND ARE NOT MEANT TO LIMIT UP-SIZING AS REQUIRED BY FIELD CONDITIONS.
5. CONDUIT POINT OF PENETRATION FROM EXTERIOR TO INTERIOR TO BE INSTALLED AND SEALED WITH A SUITABLE SEALING COMPOUND.
6. DC WIRING LIMITED TO MODULE FOOTPRINT W/ ENPHASE AC SYSTEM.
7. ENPHASE WIRING SYSTEMS SHALL BE LOCATED AND SECURED UNDER THE ARRAY W/ SUITABLE WIRING CLIPS.
8. MAX DC VOLTAGE CALCULATED USING MANUFACTURER PROVIDED TEMP COEFFICIENT FOR VOC UNLESS NOT AVAILABLE.
9. ALL INVERTERS, MOTOR GENERATORS, PHOTOVOLTAIC MODULES, PHOTOVOLTAIC PANELS, AC PHOTOVOLTAIC MODULES, DC COMBINERS, DC-TO-DC CONVERTERS,SOURCE CIRCUIT COMBINERS, AND CHARGE CONTROLLERS INTENDED FOR USE IN A PHOTOVOLTAIC POWER SYSTEM WILL BE IDENTIFIED AND LISTED FOR THE APPLICATION PER NEC 690.4(B).
10. ALL SIGNAGE TO BE PLACED IN ACCORDANCE WITH LOCAL BUILDING CODE.
11. TERMINALS AND LUGS WILL BE TIGHTENED TO MANUFACTURER TORQUE SPECIFICATIONS (WHEN PROVIDED) IN ACCORDANCE WITH NEC CODE 110.14(D) ON ALL ELECTRICAL CONNECTIONS.

EQUIPMENT LOCATIONS

1. PROPER ACCESS AND WORKING CLEARANCE AROUND EXISTING AND PROPOSED ELECTRICAL EQUIPMENT WILL BE PROVIDED AS PER SECTION NEC 110.26.
2. EQUIPMENT INSTALLED IN DIRECT SUNLIGHT MUST BE RATED FOR EXPECTED OPERATING TEMPERATURE AS SPECIFIED BY NEC 690.31(A) AND NEC TABLE 310.15(B).
3. ALL EQUIPMENT SHALL BE INSTALLED ACCESSIBLE TO QUALIFIED PERSONNEL ACCORDING TO NEC APPLICABLE CODES.
4. ALL COMPONENTS ARE LISTED FOR THEIR PURPOSE AND RATED FOR OUTDOOR USAGE WHEN APPROPRIATE.

AERIAL VIEW



PROJECT INFORMATION:

NUMBER OF STORIES: 2
CONDUIT RUN: Interior
ECOBEE QTY: 1
LIGHT BULB QTY: 0
PV METER: Not Required

Eric Sumsion

COLORADO LICENSED ERIC SUMSION 56167 10/28/2021 PROFESSIONAL ENGINEER

A

ROOF TYPE (1) INFORMATION:
ROOF TYPE: Comp Shingle
FRAMING TYPE: Rafter
SHEATHING TYPE: TONGUE AND GROOVE
STANDOFF: SFM Infinity Switchblade Flashkit6
RACKING: Unirac SFM Infinity @ 48" OC Portrait / 48" OC Landscape
NUMBER OF ATTACHMENTS: 27

ROOF TYPE (2) INFORMATION *(IF APPLICABLE)*:
***SEE PV4.2**

SYSTEM TO BE INSTALLED INFORMATION:

SYSTEM SIZE: 4.4 kW DC
MODULE TYPE: (11) REC Solar REC400AA Pure
INVERTER TYPE: Enphase IQ7PLUS-72-2-US
MONITORING: Enphase IQ Combiner 3 X-IQ-AM1-240-3

DESIGN CRITERIA

WIND SPEED: 117 MPH
GROUND SNOW LOAD: 35 lb/ft²
WIND EXPOSURE FACTOR: B
SEISMIC DESIGN CATEGORY: B

SITE SPECIFICATIONS

CONSTRUCTION - V-B
ZONING: RESIDENTIAL

SCOPE OF WORK

INSTALLATION OF UTILITY INTERACTIVE PHOTOVOLTAIC SOLAR SYSTEM AND ANY NECESSARY ADDITIONAL WORK NEEDED FOR INSTALLATION.

SHEET INDEX

VECTOR ENGINEERS
651 W. GALENA PARK BLVD. STE. 101
DRAPER, UTAH 84020
PHONE (801) 990-1775
WWW.VECTORSE.COM

Firm License Number: 20181009799
VSE Project Number: U2001.2556.211

Vector Structural Engineering has reviewed the existing structure with loading from the solar array and screw connections to the existing framing. The design of the racking system, racking connections, and all other structural is by others. Mechanical, architectural, and all other nonstructural aspects of the design are by others. Electrical is by others, unless stamped by Dean Levorsen.

UTILITY COMPANY:
Fort Collins Utility

PERMIT ISSUER:
City of Fort Collins

BLUE RAVEN SOLAR
1403 N. Research Way
Orem, UT 84097

800.377.4480
WWW.BLUERAVENSOLAR.COM

NABCEP CERTIFIED
PV INSTALLATION PROFESSIONAL
Scott Gurney
#PV-011719-015866

CONTRACTOR:
BRS FIELD OPS
385-498-6700

CUSTOMER INFORMATION:
Janice DeVore
1617 Sheely Dr
Fort Collins, Colorado 80526

DC SYSTEM SIZE:
4.4 kW DC

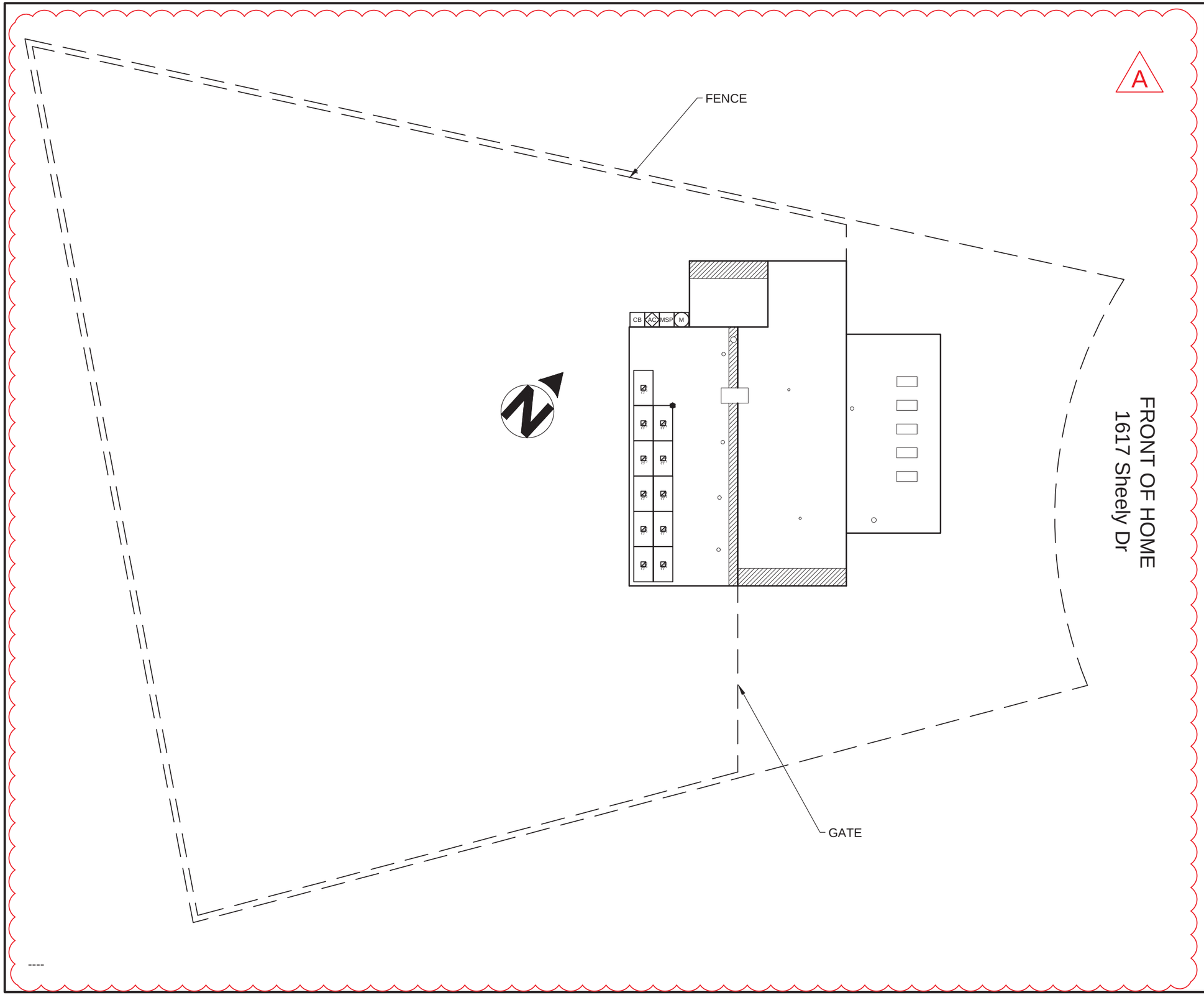
DRAWING BY:
Eric Thomas

PLOT DATE:
October 20, 2021

PROJECT NUMBER:
372602

SHEET NAME:
COVER SHEET

REVISION:	PAGE NUMBER:
A	PV1



LEGEND

- JUNCTION BOX
- M — UTILITY METER
- MSP — MAIN SERVICE PANEL
- AC — AC DISCONNECT
- CB — COMBINER BOX
- LC — LOAD CENTER
- SUB — SUBPANEL
- PV — PV METER
- TS — TRANSFER SWITCH
- FIRE SETBACK
- TRENCHING
- PROPERTY LINE

SCALE: 1/16" = 1'-0"

BLUE RAVEN SOLAR

1403 N. Research Way
Orem, UT 84097

800.377.4480
WWW.BLUERAVENSOLAR.COM

NABCEP CERTIFIED
PV INSTALLATION PROFESSIONAL
Scott Gurney
#PV-011719-015866

CONTRACTOR:
BRS FIELD OPS
385-498-6700

CUSTOMER INFORMATION:
Janice DeVore
1617 Sheely Dr
Fort Collins, Colorado 80526

DC SYSTEM SIZE:
4.4 kW DC

DRAWING BY:
Eric Thomas

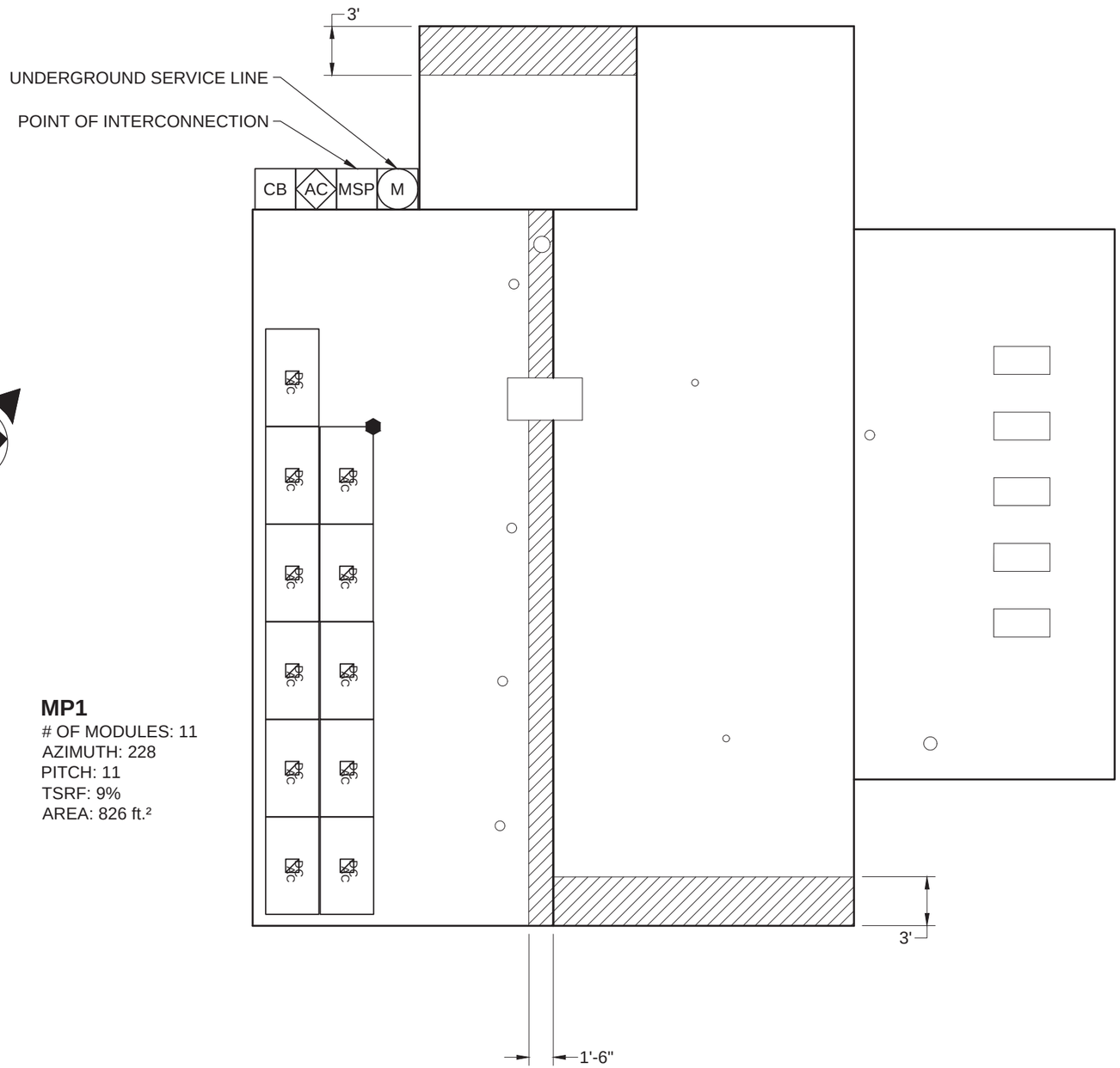
PLOT DATE:
October 20, 2021

PROJECT NUMBER:
372602

SHEET NAME:
SITE PLAN

REVISION:	PAGE NUMBER:
A	PV2

A



FRONT OF HOME

MP1
OF MODULES: 11
AZIMUTH: 228
PITCH: 11
TSRF: 9%
AREA: 826 ft.²

LEGEND

- JUNCTION BOX
- M — UTILITY METER
- MSP — MAIN SERVICE PANEL
- AC — AC DISCONNECT
- CB — COMBINER BOX
- LC — LOAD CENTER
- SUB — SUBPANEL
- PV — PV METER
- TS — TRANSFER SWITCH
- FIRE SETBACK
- TRENCHING
- PROPERTY LINE

SCALE: 1/8" = 1'-0"

VECTOR Engineers
651 W. GALENA PARK BLVD. STE. 101
DRAPER, UTAH 84020
PHONE (801) 990-1775
www.vectorse.com

COLORADO LICENSED
ERIC SUMSION
56167
10/28/2021
PROFESSIONAL ENGINEER

Firm License Number: 20181009799
VSE Project Number: U2001.2556.211

Vector Structural Engineering has reviewed the existing structure with loading from the solar array and screw connections to the existing framing. The design of the racking system, racking connections, and all other structural is by others. Mechanical, architectural, and all other nonstructural aspects of the design are by others. Electrical is by others, unless stamped by Dean Levorsen.

BLUE RAVEN SOLAR
1403 N. Research Way
Orem, UT 84097
800.377.4480
WWW.BLUERAVENSOLAR.COM

NABCEP CERTIFIED
PV INSTALLATION PROFESSIONAL
Scott Gurney
#PV-011719-015866

CONTRACTOR:
BRS FIELD OPS
385-498-6700

CUSTOMER INFORMATION:
Janice DeVore
1617 Sheely Dr
Fort Collins, Colorado 80526

DC SYSTEM SIZE:
4.4 kW DC

DRAWING BY:
Eric Thomas

PLOT DATE:
October 20, 2021

PROJECT NUMBER:
372602

SHEET NAME:
ROOF PLAN

REVISION:	PAGE NUMBER:
A	PV3

STRUCTURAL INFORMATION:

ROOF TYPE (1): A

ROOF TYPE: Comp Shingle
SHEATHING TYPE: TONGUE AND GROOVE
FRAMING TYPE: Rafter
FRAMING SIZE: 2x8 @ 24" OC
CEILING JOIST SIZE: 2x8 @ 16" OC

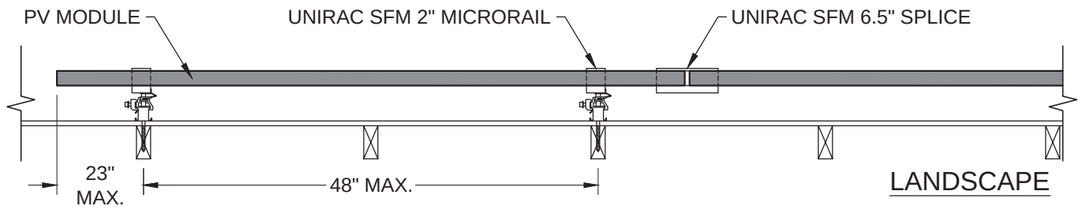
STANDOFF: SFM Infinity Switchblade Flashkit6
RACKING: Unirac SFM Infinity
@ 48" OC Portrait / 48" OC Landscape
NUMBER OF ATTACHMENTS: 27

PV MODULE COUNT: 11 Modules
TOTAL ARRAY AREA: 192.6 ft² (17.51ft²/panel)
TOTAL ROOF AREA: 2540 ft²
ARRAY/ROOF AREA: 7.6%
ARRAY WEIGHT: 550 lbs (50 lbs/panel)
DISTRIBUTED LOAD: 2.86 lbs/ft²
POINT LOAD: 20.37 lbs/attachment

STRUCTURAL NOTES:

None

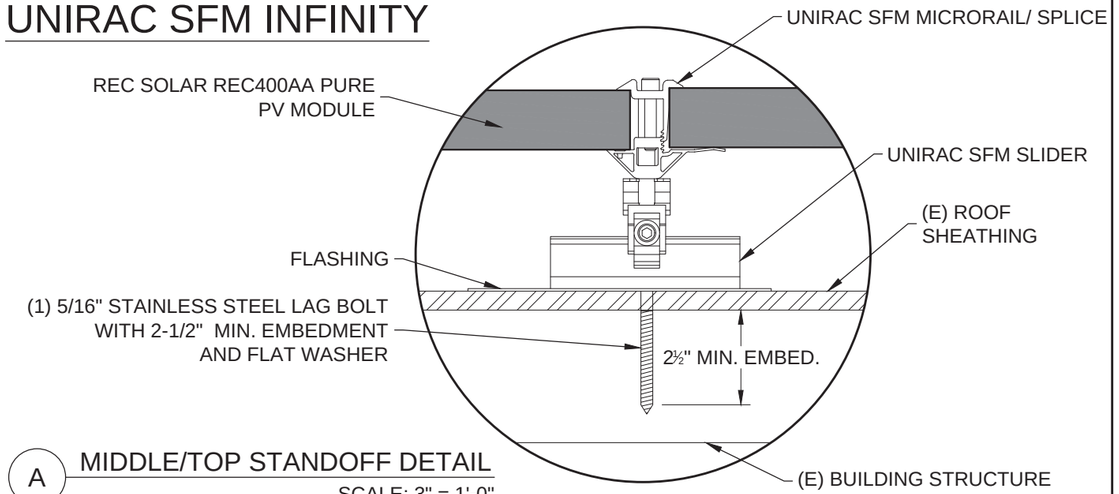
*NOTE: LISTED NUMBER OF ATTACHMENT POINTS ARE AN ESTIMATE ONLY AND MAY VARY BASED ON FIELD CONDITIONS. MAXIMUM ATTACHMENT SPACING TO BE FOLLOWED PER ENGINEER OF RECORD SPECIFICATIONS.



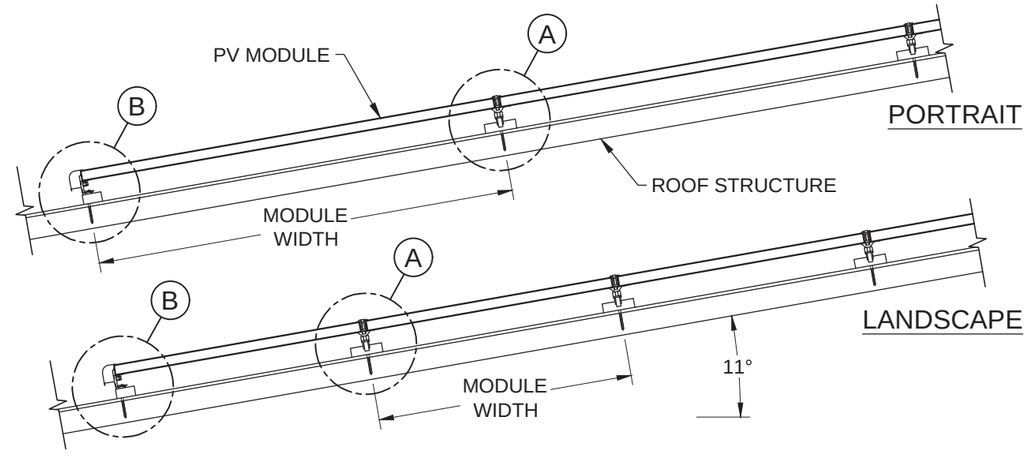
C ATTACHMENT SPACING- FRONT VIEW
SCALE: 3/4" = 1'-0"

-RACKING ATTACHMENTS TO BE STAGGERED BY SHIFTING EACH SUBSEQUENT ROW OF ATTACHMENTS OVER ONE RAFTER.

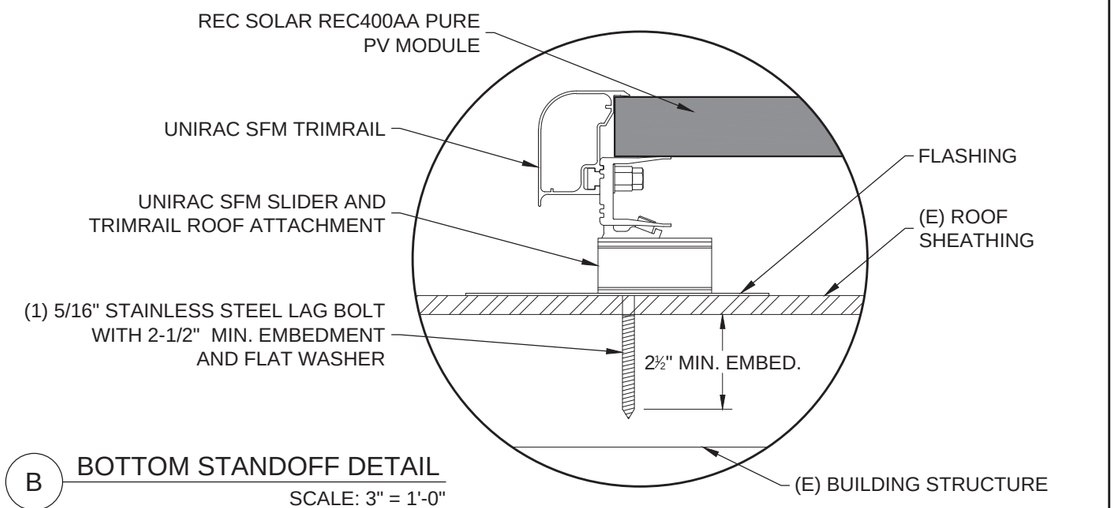
UNIRAC SFM INFINITY



A MIDDLE/TOP STANDOFF DETAIL
SCALE: 3" = 1'-0"



D ATTACHMENT SPACING- SIDE VIEW
SCALE: 1/2" = 1'-0"



B BOTTOM STANDOFF DETAIL
SCALE: 3" = 1'-0"

VECTOR ENGINEERS
651 W. GALENA PARK BLVD. STE. 101
DRAPER, UTAH 84020
PHONE (801) 990-1775
WWW.VECTORSE.COM

COLORADO LICENSED
ERIC SUMSION
56167
10/28/2021
PROFESSIONAL ENGINEER

Firm License Number: 20181009799
VSE Project Number: U2001.2556.211

Vector Structural Engineering has reviewed the existing structure with loading from the solar array and screw connections to the existing framing. The design of the racking system, racking connections, and all other structural is by others. Mechanical, architectural, and all other nonstructural aspects of the design are by others. Electrical is by others, unless stamped by Dean Levorsen.

BLUE RAVEN SOLAR
1403 N. Research Way
Orem, UT 84097
800.377.4480
WWW.BLUERAVENSOLAR.COM

NABCEP CERTIFIED
PV INSTALLATION PROFESSIONAL
Scott Gurney
#PV-011719-015866

CONTRACTOR:
BRS FIELD OPS
385-498-6700

CUSTOMER INFORMATION:
Janice DeVore
1617 Sheely Dr
Fort Collins, Colorado 80526

DC SYSTEM SIZE:
4.4 kW DC

DRAWING BY:
Eric Thomas

PLOT DATE:
October 20, 2021

PROJECT NUMBER:
372602

SHEET NAME:
STRUCTURAL

REVISION: A

PAGE NUMBER: PV4

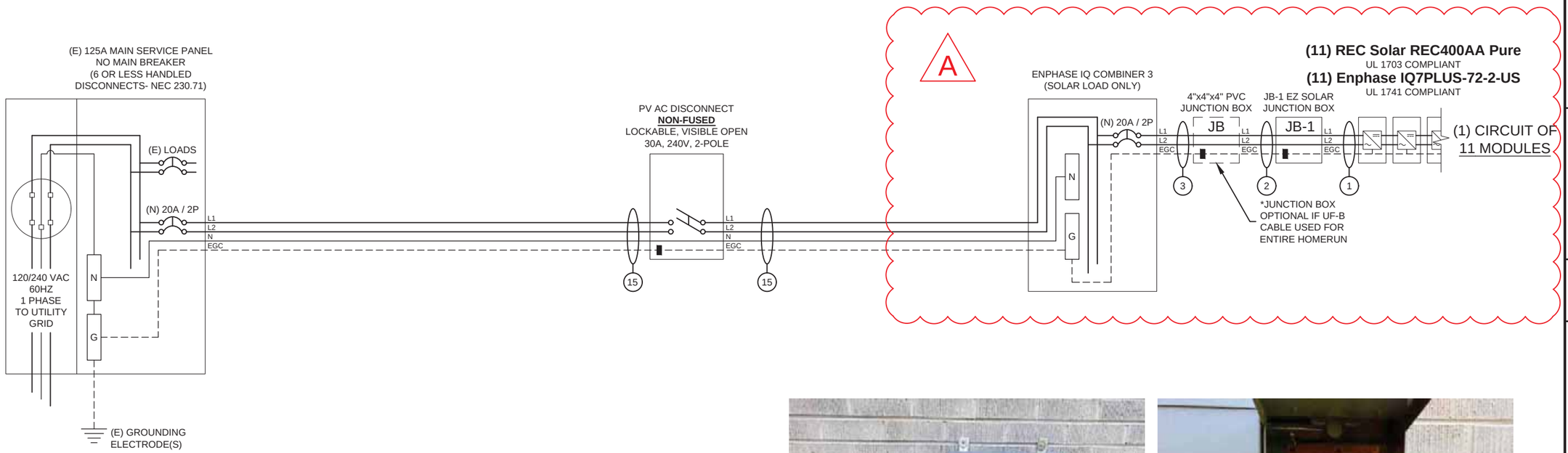
15	(1) 10 AWG THHN/THWN-2, CU., BLACK (L1) (1) 10 AWG THHN/THWN-2, CU., RED (L2) (1) 10 AWG THHN/THWN-2, CU., WHITE (N) (1) 10 AWG THHN/THWN-2, CU., GREEN (EGC) (1) 3/4 INCH EMT	14.5 A AC 240 V AC EXTERIOR	3	(1) 12 - 2 UF-B W/G, THHN/THWN-2, SOLID CU. (1) 3/4 INCH EMT	MAX 14.5 A AC 240 V AC EXTERIOR	2	(1) 12 - 2 UF-B (or NM) W/G, THHN/THWN-2, SOLII OR 12-2 TC-ER,THHN/THWN-2, CU., 90C	MAX 14.5 A AC 240 V AC INTERIOR	1	(1) 12-2 TC-ER,THHN/THWN-2, CU. (1) 6 AWG BARE, CU (EGC)	MAX 14.5 A AC 240 V AC EXTERIOR

DESIGNER NOTES:

SUPPLY SIDE BREAKER, EXTERIOR MSPPER 2020 NEC, THE AC DISCONNECT MUST REQUIRE A TOOL TO OPEN. USE A NUT AND BOLT TO FASTEN THE DISCONNECT COVER.

ELECTRICAL NOTES:

1. ALL CONDUIT TO BE RAN AT LEAST 7/8 IN. ABOVE ROOF SURFACE WHERE EXPOSED TO SUNLIGHT.
2. TERMINALS AND LUGS WILL BE TIGHTENED TO MANUFACTURER TORQUE SPECIFICATIONS (WHEN PROVIDED) IN ACCORDANCE WITH NEC CODE 110.14(D) ON ALL ELECTRICAL CONNECTIONS.
3. CONDUIT AND CONDUCTOR SPECIFICATIONS ARE BASED ON MINIMUM CODE REQUIREMENTS AND ARE NOT MEANT TO LIMIT UP-SIZING AS REQUIRED BY FIELD CONDITIONS



INTERCONNECTION NOTES

705.11 AN ELECTRIC POWER PRODUCTION SOURCE, WHERE CONNECTED TO THE SUPPLY SIDE OF THE SERVICE DISCONNECTING MEANS AS PERMITTED IN *230.82(6)*, SHALL COMPLY WITH *705.11 (A)* THROUGH *(E)*.

UTILITY COMPANY: Fort Collins Utility **PERMIT ISSUER:** City of Fort Collins

BLUE RAVEN SOLAR

1403 N. Research Way
Orem, UT 84097

800.377.4480
WWW.BLUERAVENSOLAR.COM

NABCEP CERTIFIED

PV INSTALLATION PROFESSIONAL
Scott Gurney
#PV-011719-015866

CONTRACTOR:
BRS FIELD OPS
385-498-6700

CUSTOMER INFORMATION:
Janice DeVore
1617 Sheely Dr
Fort Collins, Colorado 80526

DC SYSTEM SIZE:
4.4 kW DC

DRAWING BY:
Eric Thomas

PLOT DATE:
October 20, 2021

PROJECT NUMBER:
372602

SHEET NAME:
ELECTRICAL

REVISION:	PAGE NUMBER:
A	PV5

MODULE SPECIFICATIONS	REC Solar REC400AA Pure
RATED POWER (STC)	400 W
MODULE VOC	48.8 V DC
MODULE VMP	42.1 V DC
MODULE IMP	9.51 A DC
MODULE ISC	10.25 A DC
VOC CORRECTION	-0.24 %/°C
VMP CORRECTION	-0.26 %/°C
SERIES FUSE RATING	25 A DC
ADJ. MODULE VOC @ ASHRAE LOW TEMP	54.4 V DC
ADJ. MODULE VMP @ ASHRAE 2% AVG. HIGH TEMP	37.6 V DC

MICROINVERTER SPECIFICATIONS	Enphase IQ7+ Microinverters
POWER POINT TRACKING (MPPT) MIN/MAX	22 - 60 V DC
MAXIMUM INPUT VOLTAGE	60 V DC
MAXIMUM DC SHORT CIRCUIT CURRENT	15 A DC
MAXIMUM USABLE DC INPUT POWER	440 W
MAXIMUM OUTPUT CURRENT	1.21 A AC
AC OVERCURRENT PROTECTION	20 A
MAXIMUM OUTPUT POWER	290 W
CEC WEIGHTED EFFICIENCY	97 %

AC PHOTOVOLATIC MODULE MARKING (NEC 690.52)	
NOMINAL OPERATING AC VOLTAGE	240 V AC
NOMINAL OPERATING AC FREQUENCY	47 - 68 HZ AC
MAXIMUM AC POWER	240 VA AC
MAXIMUM AC CURRENT	1.0 A AC
MAXIMUM OCPD RATING FOR AC MODULE	20 A AC

DESIGN LOCATION AND TEMPERATURES	
TEMPERATURE DATA SOURCE	ASHRAE 2% AVG. HIGH TEMP
STATE	Colorado
CITY	Fort Collins
WEATHER STATION	FORT COLLINS (AWOS)
ASHRAE EXTREME LOW TEMP (°C)	-23
ASHRAE 2% AVG. HIGH TEMP (°C)	34

SYSTEM ELECTRICAL SPECIFICATIONS	CIR 1	CIR 2	CIR 3	CIR 4	CIR 5	CIR 6
NUMBER OF MODULES PER MPPT	11					
DC POWER RATING PER CIRCUIT (STC)	4400					
TOTAL MODULE NUMBER	11 MODULES					
STC RATING OF ARRAY	4400W DC					
AC CURRENT @ MAX POWER POINT (IMP)	13.3					
MAX. CURRENT (IMP X 1.25)	16.6375					
OCPD CURRENT RATING PER CIRCUIT	20					
MAX. COMB. ARRAY AC CURRENT (IMP)	13.3					
MAX. ARRAY AC POWER	3190W AC					

AC VOLTAGE RISE CALCULATIONS	DIST (FT)	COND.	↑RISE(V)	VEND(V)	%VRISE
VRISE SEC. 1 (MICRO TO JBOX)	39.6	12 Cu.	1.76	241.76	0.73%
VRISE SEC. 2 (JBOX TO COMBINER BOX)	40	12 Cu.	2.15	242.15	0.90%
VRISE SEC. 3 (COMBINER BOX TO POI)	10	10 Cu.	0.34	240.34	0.14%
TOTAL VRISE			4.25	244.25	

PHOTOVOLTAIC AC DISCONNECT OUTPUT LABEL (NEC 690.54)	
AC OUTPUT CURRENT	13.3 A AC
NOMINAL AC VOLTAGE	240 V AC

CONDUCTOR SIZE CALCULATIONS

MICROINVERTER TO JUNCTION BOX (1)	MAX. SHORT CIRCUIT CURRRENT (ISC) =		13.3	A AC	
	MAX. CURRENT (ISC X1.25) =		16.6	A AC	
	CONDUCTOR (TC-ER, COPPER (90°C)) =		12	AWG	
	CONDUCTOR RATING =		30	A	
	AMB. TEMP. AMP. CORRECTION =	34	0.96		
	ADJUSTED AMP. =		28.8	>	16.6
JUNCTION BOX TO JUNCTION BOX (2)	MAX. SHORT CIRCUIT CURRRENT (ISC) =		13.3	A AC	
	MAX. CURRENT (ISC X1.25) =		16.6	A AC	
	CONDUCTOR (UF-B, COPPER (60°C)) =	18	12	AWG	
	CONDUCTOR RATING =	18	20	A	
	CONDUIT FILL DERATE =	2	1		
	AMB. TEMP. AMP. CORRECTION =	34	0.96		
	ADJUSTED AMP. =		19.2	>	16.6
JUNCTION BOX TO COMBINER BOX (3)	MAX. SHORT CIRCUIT CURRRENT (ISC) =		13.3	A AC	
	MAX. CURRENT (ISC X1.25) =		16.6	A AC	
	CONDUCTOR (UF-B, COPPER (60°C)) =	18	12	AWG	
	CONDUCTOR RATING =	18	20	A	
	CONDUIT FILL DERATE =	2	1		
	AMB. TEMP. AMP. CORRECTION =	34	0.96		
	ADJUSTED AMP. =		19.2	>	16.6
COMBINER BOX TO MAIN PV OCPD (15)	INVERTER RATED AMPS =		13.3	A AC	
	MAX. CURRENT (RATED AMPS X1.25) =		16.64	A AC	
	CONDUCTOR (THWN-2, COPPER (75°C TERM.)) =	18	10	AWG	
	CONDUCTOR RATING =	18	35	A	
	CONDUIT FILL DERATE =	3	1		
	AMB. TEMP. AMP. CORRECTION =	34	0.96		
	ADJUSTED AMP. =		33.6	>	16.6

GROUNDING NOTES

1. A GROUNDING ELECTRODE SYSTEM IN ACCORDANCE WITH [NEC 690.47] AND [NEC 250.50-60] SHALL BE PROVIDED. PER [NEC 690.47], THE GROUNDING ELECTRODE SYSTEM OF AN EXISTING BUILDING MAY BE USED AND BE BONDED AT THE SERVICE ENTRANCE. IF EXISTING SYSTEM IS INACCESSIBLE, OR INADEQUATE, OR IS ONLY METALLIC WATER PIPING, A SUPPLEMENTAL GROUNDING ELECTRODE WILL BE USED AT THE INVERTER LOCATION CONSISTING OF A UL LISTED 8 FT GROUND ROD WITH ACORN CLAMP.
2. THE GROUNDING ELECTRODE CONDUCTOR SHALL BE PROTECTED FROM PHYSICAL DAMAGE BETWEEN THE GROUNDING ELECTRODE AND THE PANEL (OR INVERTER) IF SMALLER THAN #6 AWG COPPER WIRE PER [NEC 250.64(B)]. THE GROUNDING ELECTRODE CONDUCTOR WILL BE CONTINUOUS, EXCEPT FOR SPLICES OR JOINTS AT BUSBARS WITHIN LISTED EQUIPMENT PER [NEC 250.64(C)].
3. GROUNDING ELECTRODE CONDUCTORS SHALL BE NO LESS THAN 8 AWG AND NO GREATER THAN 6 AWG COPPER AND BONDED TO THE EXISTING GROUNDING ELECTRODE TO PROVIDE FOR A COMPLETE SYSTEM.
4. PV SYSTEM SHALL BE GROUNDED IN ACCORDANCE TO [NEC 250.21], [NEC TABLE 250.122], AND ALL METAL PARTS OR MODULE FRAMES ACCORDING TO [NEC 690.46].
5. MODULE SOURCE CIRCUITS SHALL BE GROUNDED IN ACCORDANCE TO [NEC 690.42].
6. THE GROUNDING CONNECTION TO A MODULE SHALL BE ARRANGED SUCH THAT THE REMOVAL OF A MODULE DOES NOT INTERRUPT A GROUNDED CONDUCTOR TO ANOTHER MODULE.
7. EACH MODULE WILL BE GROUNDED USING THE SUPPLIED CONNECTION POINTS IDENTIFIED IN THE MANUFACTURER'S INSTALLATION INSTRUCTIONS.
8. ENCLOSURES SHALL BE PROPERLY PREPARED WITH REMOVAL OF PAINT/FINISH AS APPROPRIATE WHEN GROUNDING EQUIPMENT WITH TERMINATION GROUNDING LUGS.
9. GROUNDING SYSTEM COMPONENTS SHALL BE LISTED FOR THEIR PURPOSE, AND GROUNDING DEVISES EXPOSED TO THE ELEMENTS SHALL BE RATED FOR DIRECT BURIAL.
10. GROUNDING AND BONDING CONDUCTORS SHALL BE COPPER, SOLID OR STRANDED, AND BARE WHEN EXPOSED.
11. EQUIPMENT GROUNDING CONDUCTORS SHALL BE SIZED ACCORDING TO [NEC 690.45] AND BE A MINIMUM OF 10 AWG WHEN NOT EXPOSED TO DAMAGE (6 AWG SHALL BE USED WHEN EXPOSED TO DAMAGE).
12. GROUNDING AND BONDING CONDUCTORS, IF INSULATED, SHALL BE COLOR CODED GREEN (OR MARKED GREEN IF 4 AWG OR LARGER).
13. ALL CONDUIT BETWEEN THE UTILITY AC DISCONNECT AND THE POINT OF CONNECTION SHALL HAVE GROUNDED BUSHINGS AT BOTH ENDS.
14. SYSTEM GEC SIZED ACCORDING TO [NEC 690.47], [NEC TABLE 250.66], DC SYSTEM GEC SIZED ACCORDING TO [NEC 250.166], MINIMUM 8 AWG WHEN INSULATED, 6 AWG WHEN EXPOSED TO DAMAGE.
15. EXPOSED NON-CURRENT CARRYING METAL PARTS OF MODULE FRAMES, EQUIPMENTS, AND CONDUCTOR ENCLOSURES SHALL BE GROUNDED IN ACCORDANCE WITH [NEC 250.134] OR [NEC 250.136(A)] REGARDLESS OF VOLTAGE.

WIRING & CONDUIT NOTES

1. ALL CONDUIT SIZES AND TYPES, SHALL BE LISTED FOR ITS PURPOSE AND APPROVED FOR THE SITE APPLICATIONS.
2. BOLTED CONNECTION REQUIRED IN DC DISCONNECTS ON THE WHITE GROUNDED CONDUCTOR (USE POLARIS BLOCK OR NEUTRAL BAR).
3. ANY CONNECTION ABOVE LIVE PARTS MUST BE WATERTIGHT. REDUCING WASHERS DISALLOWED ABOVE LIVE PARTS, MEYERS HUBS RECOMMENDED
4. UV RESISTANT CABLE TIES (NOT ZIP TIES) USED FOR PERMANENT WIRE MANAGEMENT OFF THE ROOF SURFACE IN ACCORDANCE WITH [NEC 110.2,110.3(A-B)].
5. SOLADECK JUNCTION BOXES MOUNTED FLUSH WITH ROOF SURFACE TO BE USED FOR WIRE MANAGEMENT AND AS FLASHED ROOF PENETRATIONS FOR INTERIOR CONDUIT RUNS.
6. ALL PV CABLES AND HOMERUN WIRES BE TYPE USE-2, AND SINGLE-CONDUCTOR CABLE LISTED AND IDENTIFIED AS PV WIRE, TYPE TC-ER, OR EQUIVALENT; ROUTED TO SOURCE CIRCUIT COMBINER BOXES AS REQUIRED.
7. ALL CONDUCTORS AND OCPD SIZES AND TYPES SPECIFIED ACCORDING TO [NEC 690.8] FOR MULTIPLE CONDUCTORS.
8. ALL PV DC CONDUCTORS IN CONDUIT EXPOSED TO SUNLIGHT SHALL BE INSTALLED AT LEAST 7/8" ABOVE THE ROOF SURFACE AND DERATED ACCORDING TO [NEC TABLE 310.15 (B)(2)(A)], [NEC TABLE 310.15(B)(3)(A)],& [NEC 310.15(B)(3)(C)].
9. EXPOSED ROOF PV DC CONDUCTORS SHALL BE USE-2, 90°C RATED, WET AND UV RESISTANT, AND UL LISTED RATED FOR 600V, UV RATED SPIRAL WRAP SHALL BE USED TO PROTECT WIRE FROM SHARP EDGES.
10. PHASE AND NEUTRAL CONDUCTORS SHALL BE DUAL RATED THHN/THWN-2 INSULATED, 90°C RATED, WET AND UV RESISTANT, RATED FOR 600V
11. 4-WIRE DELTA CONNECTED SYSTEMS HAVE THE PHASE WITH THE HIGHER VOLTAGE TO GROUND MARKED ORANGE OR IDENTIFIED BY OTHER EFFECTIVE MEANS.
12. ALL SOURCE CIRCUITS SHALL HAVE INDIVIDUAL SOURCE CIRCUIT PROTECTION
13. VOLTAGE DROP LIMITED TO 2% FOR DC CIRCUITS AND 3% FOR AC CIRCUITS
14. NEGATIVE GROUNDED SYSTEMS DC CONDUCTORS SHALL BE COLOR CODED AS FOLLOWS: DC POSITIVE- RED (OR MARKED RED), DC NEGATIVE- GREY (OR MARKED GREY)
15. POSITIVE GROUNDED SYSTEMS DC CONDUCTORS COLOR CODED:
DC POSITIVE- GREY (OR MARKED GREY), DC NEGATIVE- BLACK (OR MARKED BLACK)
16. AC CONDUCTORS >4AWG COLOR CODED OR MARKED: PHASE A OR L1- BLACK, PHASE B OR L2- RED, PHASE C OR L3- BLUE, NEUTRAL- WHITE/GRAY
* USE-2 IS NOT INDOOR RATED BUT PV CABLE IS RATED THWN/THWN-2 AND MAY BE USED INSIDE
** USE-2 IS AVAILABLE AS UV WHITE
17. RIGID CONDUIT, IF INSTALLED, (AND/OR NIPPLES) MUST HAVE A PULL BUSHING TO PROTECT WIRES.
18. IF CONDUIT DETERMINED TO BE RAN THROUGH ATTIC IN FIELD THEN CONDUIT WILL BE EITHER EMT, FMC, OR MC CABLE IF DC CURRENT COMPLYING WITH [NEC 690.31], [NEC 250.118(10)]. DISCONNECTING MEANS SHALL COMPLY WITH [NEC 690.13] AND [NEC 690.15].
19. CONDUIT RAN THROUGH ATTIC WILL BE AT LEAST 18" BELOW ROOF SURFACE COMPLYING WITH [NEC 230.6(4)] AND SECURED NO GREATER THAN 6' APART PER [NEC 330.30(B)].

A

BLUE RAVEN SOLAR
1403 N. Research Way
Orem, UT 84097
800.377.4480
WWW.BLUERAVENSOLAR.COM

NABCEP CERTIFIED
PV INSTALLATION PROFESSIONAL
Scott Gurney
#PV-011719-015866

CONTRACTOR:
BRS FIELD OPS
385-498-6700

CUSTOMER INFORMATION:
Janice DeVore
1617 Sheely Dr
Fort Collins, Colorado 80526

DC SYSTEM SIZE:
4.4 kW DC

DRAWING BY:
Eric Thomas

PLOT DATE:
October 20, 2021

PROJECT NUMBER:
372602

SHEET NAME:
ELEC CALCS

REVISION:
A

PAGE NUMBER:
PV6

STANDARD LABELS

⚠ WARNING
ELECTRIC SHOCK HAZARD
TERMINALS ON THE LINE AND LOAD SIDES MAY BE ENERGIZED IN THE OPEN POSITION

LABEL 1
FOR PV SYSTEM DISCONNECTING MEANS WHERE THE LINE AND LOAD TERMINALS MAY BE ENERGIZED IN THE OPEN POSITION. *[NEC 690.13(B)]*

PHOTOVOLTAIC SYSTEM
⚠ AC DISCONNECT ⚠
RATED AC OUTPUT CURRENT 13.31 A
NOMINAL OPERATING AC VOLTAGE 240 V

LABEL 2
SHALL BE MARKED AT AN ACCESSIBLE LOCATION AT THE DISCONNECTING MEANS AS A POWER SOURCE AND WITH THE RATED AC OUTPUT CURRENT AND THE NOMINAL OPERATING AC VOLTAGE. *[NEC 690.54]*

⚠ WARNING
DUAL POWER SUPPLY
SOURCES: UTILITY GRID AND PV SOLAR ELECTRIC SYSTEM

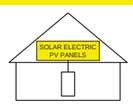
LABEL 3
IF INTERCONNECTING LOAD SIDE, INSTALL THIS LABEL ANYWHERE THAT IS POWERED BY BOTH THE UTILITY AND THE SOLAR PV SYSTEM, IE. MAIN SERVICE PANEL AND SUBPANELS. *[NEC 705.12(B)(3)]*

⚠ WARNING
POWER SOURCE OUTPUT CONNECTION
DO NOT RELOCATE THIS OVERCURRENT DEVICE

LABEL 4
APPLY TO THE DISTRIBUTION EQUIPMENT ADJACENT TO THE BACK-FED BREAKER FROM THE POWER SOURCE. *[NEC 705.12(B)(2)]*

⚠ WARNING
THIS EQUIPMENT FED BY MULTIPLE SOURCES. TOTAL RATING OF ALL OVERCURRENT DEVICES, EXCLUDING MAIN SUPPLY OVERCURRENT DEVICE, SHALL NOT EXCEED AMPACITY OF BUSBAR.

LABEL 5
APPLY TO THE PV COMBINER BOX
[NEC 705.12 (3)(3)]

SOLAR PV SYSTEM EQUIPPED WITH RAPID SHUTDOWN
TURN RAPID SHUTDOWN SWITCH TO THE "OFF" POSITION TO SHUT DOWN PV SYSTEM AND REDUCE SHOCK HAZARD IN THE ARRAY


LABEL 6
BUILDINGS WITH PV SYSTEMS SHALL HAVE A PERMANENT LABEL LOCATED AT EACH SERVICE EQUIPMENT LOCATION TO WHICH THE PV SYSTEMS ARE CONNECTED OR AT AN APPROVED READILY VISIBLE LOCATION AND SHALL INDICATE THE LOCATION OF RAPID SHUTDOWN INITIATION DEVICES. *[NEC 690.56(C)]*

RAPID SHUTDOWN SWITCH FOR SOLAR PV SYSTEM

LABEL 7
SIGN LOCATED AT RAPID SHUT DOWN DISCONNECT SWITCH *[NEC 690.56(C)(2)]*

⚠ WARNING
MAIN DISTRIBUTION UTILITY DISCONNECT(S)
POWER TO THIS BUILDING IS ALSO SUPPLIED FROM A ROOF MOUNTED SOLAR ARRAY WITH A RAPID SHUTDOWN DISCONNECTING MEANS GROUPED AND LABELED WITHIN LINE OF SITE AND 10 FT OF THIS LOCATION

LABEL 8
PERMANENT PLAQUE OR DIRECTORY DENOTING THE LOCATION OF ALL ELECTRIC POWER SOURCE DISCONNECTING MEANS ON OR IN THE PREMISES SHALL BE INSTALLED AT EACH SERVICE EQUIPMENT LOCATION AND AT THE LOCATION(S) OF THE SYSTEM DISCONNECT(S) FOR ALL ELECTRIC POWER PRODUCTION SOURCES CAPABLE OF BEING INTERCONNECTED. *[2017 NEC 705.10]*

⚠ WARNING
POWER TO THIS BUILDING IS ALSO SUPPLIED FROM MAIN DISTRIBUTION UTILITY DISCONNECT LOCATED

LABEL 9
PERMANENT PLAQUE OR DIRECTORY DENOTING THE LOCATION OF ALL ELECTRIC POWER SOURCE DISCONNECTING MEANS ON OR IN THE PREMISES SHALL BE INSTALLED AT EACH SERVICE EQUIPMENT LOCATION AND AT THE LOCATION(S) OF THE SYSTEM DISCONNECT(S) FOR ALL ELECTRIC POWER PRODUCTION SOURCES CAPABLE OF BEING INTERCONNECTED. *[2017 NEC 705.10]*

⚠ WARNING
POWER TO THIS BUILDING IS ALSO SUPPLIED FROM A ROOF MOUNTED SOLAR ARRAY. SOLAR ARRAY RAPID SHUTDOWN DISCONNECT IS LOCATED OUTSIDE NEXT TO THE UTILITY METER.

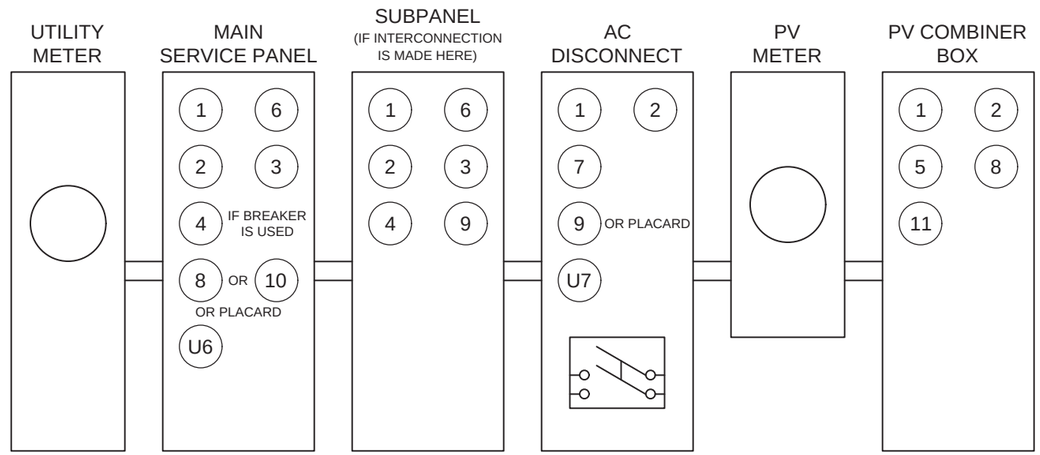
LABEL 10
PERMANENT PLAQUE OR DIRECTORY TO BE LOCATED AT MAIN SERVICE EQUIPMENT DENOTING THE LOCATION OF THE RAPID SHUTDOWN SYSTEM DISCONNECTING MEANS IF SOLAR ARRAY RAPID SHUTDOWN DISCONNECTING SWITCH IS NOT GROUPED AND WITHIN LINE OF SITE OF MAIN SERVICE DISCONNECTING MEANS.
[2017 NEC 705.10 AND 690.56(C)(1)]

⚠ WARNING
PHOTOVOLTAIC SYSTEM COMBINER PANEL
DO NOT ADD LOADS

LABEL 11
PERMANENT PLAQUE OR DIRECTORY TO BE LOCATED AT AC COMBINER PANEL. *[NEC 110.21(B)]*

WARNING: PHOTOVOLTAIC POWER SOURCE

LABEL 12
AT EXPOSED RACEWAYS, CABLE TRAYS, COVERS AND ENCLOSURES OF JUNCTION BOXES, AND OTHER WIRING METHODS. *[NEC 690.31(G)(3&4)]*



LABELING NOTES

1) LABELS CALLED OUT ACCORDING TO ALL COMMON CONFIGURATIONS. ELECTRICIAN TO DETERMINE EXACT REQUIREMENTS IN THE FIELD PER CURRENT NEC AND LOCAL CODES AND MAKE APPROPRIATE ADJUSTMENTS.
2) LABELING REQUIREMENTS BASED ON THE 2017 & 2020 NEC CODE, OSHA STANDARD 19010.145, ANSIZ535.
3) MATERIAL BASED ON THE REQUIREMENTS OF THE AHJ.
4) LABELS TO BE OF SUFFICIENT DURABILITY TO WITHSTAND THE ENVIRONMENT INVOLVED AND SHALL NOT BE HANDWRITTEN [NEC 110.21]

ADDITIONAL LABELS

1 OF 2 SERVICE DISCONNECTS

LABEL U6
IF SUPPLY SIDE TAP:
SIGN TO BE LOCATED AT MAIN SERVICE PANEL.

2 OF 2 SERVICE DISCONNECTS

LABEL U7
IF SUPPLY SIDE TAP:
SIGN TO BE LOCATED AT FUSED AC DISCONNECT.

*ELECTRICAL DIAGRAM SHOWN ABOVE IS FOR LABELING PURPOSES ONLY. NOT AN ACTUAL REPRESENTATION OF EQUIPMENT AND CONNECTIONS TO BE INSTALLED. LABEL LOCATIONS PRESENTED MAY VARY DEPENDING ON TYPE OF INTERCONNECTION METHOD AND LOCATION PRESENTED ON 3 LINE DIAGRAM. 3 LINE DIAGRAM ON PV5 TO REFLECT ACTUAL REPRESENTATION OF PROPOSED SCOPE OF WORK.

BLUE RAVEN SOLAR
1403 N. Research Way
Orem, UT 84097
800.377.4480
WWW.BLUERAVENSOLAR.COM

NABCEP CERTIFIED
PV INSTALLATION PROFESSIONAL
Scott Gurney
#PV-011719-015866

CONTRACTOR:
BRS FIELD OPS
385-498-6700

CUSTOMER INFORMATION:
Janice DeVore
1617 Sheely Dr
Fort Collins, Colorado 80526

DC SYSTEM SIZE:
4.4 kW DC

DRAWING BY:
Eric Thomas

PLOT DATE:
October 20, 2021

PROJECT NUMBER:
372602

SHEET NAME:
LABELS

REVISION: A

PAGE NUMBER: PV7

Data Sheet
Enphase Microinverters
Region: AMERICAS

Enphase IQ 7 and IQ 7+ Microinverters

The high-powered smart grid-ready **Enphase IQ 7 Micro™** and **Enphase IQ 7+ Micro™** dramatically simplify the installation process while achieving the highest system efficiency.

Part of the Enphase IQ System, the IQ 7 and IQ 7+ Microinverters integrate with the Enphase IQ Envoy™, Enphase IQ Battery™, and the Enphase Enlighten™ monitoring and analysis software.

IQ Series Microinverters extend the reliability standards set forth by previous generations and undergo over a million hours of power-on testing, enabling Enphase to provide an industry-leading warranty of up to 25 years.

Easy to Install

- Lightweight and simple
- Faster installation with improved, lighter two-wire cabling
- Built-in rapid shutdown compliant (NEC 2014 & 2017)

Productive and Reliable

- Optimized for high powered 60-cell/120 half-cell and 72-cell/144 half-cell* modules
- More than a million hours of testing
- Class II double-insulated enclosure
- UL listed

Smart Grid Ready

- Complies with advanced grid support, voltage and frequency ride-through requirements
- Remotely updates to respond to changing grid requirements
- Configurable for varying grid profiles
- Meets CA Rule 21 (UL 1741-SA)

* The IQ 7+ Micro is required to support 72-cell/144 half-cell modules.

CERTIFIED

To learn more about Enphase offerings, visit **enphase.com**

Enphase IQ 7 and IQ 7+ Microinverters

INPUT DATA (DC)	IQ7-60-2-US		IQ7PLUS-72-2-US	
Commonly used module pairings[1]	235 W - 350 W +		235 W - 440 W +	
Module compatibility	60-cell/120 half-cell PV modules only		60-cell/120 half-cell and 72-cell/144 half-cell PV modules	
Maximum input DC voltage	48 V		60 V	
Peak power tracking voltage	27 V - 37 V		27 V - 45 V	
Operating range	16 V - 48 V		16 V - 60 V	
Min/Max start voltage	22 V / 48 V		22 V / 60 V	
Max DC short circuit current (module Isc)	15 A		15 A	
Overvoltage class DC port	II		II	
DC port backfeed current	0 A		0 A	
PV array configuration	1 x 1 ungrounded array; No additional DC side protection required; AC side protection requires max 20A per branch circuit			
OUTPUT DATA (AC)	**IQ 7 Microinverter**		**IQ 7+ Microinverter**	
Peak output power	250 VA		295 VA	
Maximum continuous output power	240 VA		290 VA	
Nominal (L-L) voltage/range[2]	240 V / 211-264 V	208 V / 183-229 V	240 V / 211-264 V	208 V / 183-229 V
Maximum continuous output current	1.0 A (240 V)	1.15 A (208 V)	1.21 A (240 V)	1.39 A (208 V)
Nominal frequency	60 Hz		60 Hz	
Extended frequency range	47 - 68 Hz		47 - 68 Hz	
AC short circuit fault current over 3 cycles	5.8 Arms		5.8 Arms	
Maximum units per 20 A (L-L) branch circuit[3]	16 (240 VAC)	13 (208 VAC)	13 (240 VAC)	11 (208 VAC)
Overvoltage class AC port	III		III	
AC port backfeed current	18 mA		18 mA	
Power factor setting	1.0		1.0	
Power factor (adjustable)	0.85 leading ... 0.85 lagging		0.85 leading ... 0.85 lagging	
EFFICIENCY	**@240 V**	**@208 V**	**@240 V**	**@208 V**
Peak efficiency	97.6 %	97.6 %	97.5 %	97.3 %
CEC weighted efficiency	97.0 %	97.0 %	97.0 %	97.0 %
MECHANICAL DATA				
Ambient temperature range	-40°C to +65°C			
Relative humidity range	4% to 100% (condensing)			
Connector type	MC4 (or Amphenol H4 UTX with additional Q-DCC-5 adapter)			
Dimensions (HxWxD)	212 mm x 175 mm x 30.2 mm (without bracket)			
Weight	1.08 kg (2.38 lbs)			
Cooling	Natural convection - No fans			
Approved for wet locations	Yes			
Pollution degree	PD3			
Enclosure	Class II double-insulated, corrosion resistant polymeric enclosure			
Environmental category / UV exposure rating	NEMA Type 6 / outdoor			
FEATURES				
Communication	Power Line Communication (PLC)			
Monitoring	Enlighten Manager and MyEnlighten monitoring options. Both options require installation of an Enphase IQ Envoy.			
Disconnecting means	The AC and DC connectors have been evaluated and approved by UL for use as the load-break disconnect required by NEC 690.			
Compliance	CA Rule 21 (UL 1741-SA) UL 62109-1, UL1741/IEEE1547, FCC Part 15 Class B, ICES-0003 Class B, CAN/CSA-C22.2 NO. 107.1-01 This product is UL Listed as PV Rapid Shut Down Equipment and conforms with NEC 2014, NEC 2017, and NEC 2020 section 690.12 and C22.1-2015 Rule 64-218 Rapid Shutdown of PV Systems, for AC and DC conductors, when installed according manufacturer's instructions.			

1. No enforced DC/AC ratio. See the compatibility calculator at https://enphase.com/en-us/support/module-compatibility.
2. Nominal voltage range can be extended beyond nominal if required by the utility.
3. Limits may vary. Refer to local requirements to define the number of microinverters per branch in your area.

ENPHASE

To learn more about Enphase offerings, visit **enphase.com**

BLUE RAVEN SOLAR
1403 N RESEARCH WAY, BUILDING J
OREM, UT 84097
800-377-4480
WWW.BLUERAVENSOLAR.COM

NABCEP CERTIFIED
PV INSTALLATION PROFESSIONAL
Scott Gurney
PV-011719-015866

CONTRACTOR:
BRS FIELD OPS
385.498.6700

SHEET NAME
SPEC SHEET

PAGE NUMBER
SS

REVISION
0

Data Sheet
Enphase Networking

Enphase IQ Combiner 3

(X-IQ-AM1-240-3)

The **Enphase IQ Combiner 3**™ with Enphase IQ Envoy™ consolidates interconnection equipment into a single enclosure and streamlines PV and storage installations by providing a consistent, pre-wired solution for residential applications. It offers up to four 2-pole input circuits and Eaton BR series busbar assembly.

Smart

- Includes IQ Envoy for communication and control
- Flexible networking supports Wi-Fi, Ethernet, or cellular
- Optional AC receptacle available for PLC bridge
- Provides production metering and optional consumption monitoring

Simple

- Reduced size from previous combiner
- Centered mounting brackets support single stud mounting
- Supports back and side conduit entry
- Up to four 2-pole branch circuits for 240 VAC plug-in breakers (not included)
- 80 A total PV or storage branch circuits

Reliable

- Durable NRTL-certified NEMA type 3R enclosure
- Five-year limited warranty
- UL listed

To learn more about Enphase offerings, visit **enphase.com**

Enphase IQ Combiner 3

MODEL NUMBER	
IQ Combiner 3 X-IQ-AM1-240-3	IQ Combiner 3 with Enphase IQ Envoy™ printed circuit board for integrated revenue grade PV **production** metering (ANSI C12.20 +/- 0.5%) and optional* **consumption** monitoring (+/- 2.5%).
ACCESSORIES and **REPLACEMENT PARTS** (not included, order separately)	
Enphase Mobile Connect™ CELLMODEM-03 (4G/12-year data plan) CELLMODEM-01 (3G/5-year data plan) CELLMODEM-M1 (4G based LTE-M/5-year data plan)	Plug and play industrial grade cellular modem with data plan for systems up to 60 microinverters. (Available in the US, Canada, Mexico, Puerto Rico, and the US Virgin Islands, where there is adequate cellular service in the installation area.)
Consumption Monitoring* CT CT-200-SPLIT * Consumption monitoring is required for Enphase Storage Systems	Split core current transformers enable whole home **consumption** metering (+/- 2.5%).
Wireless USB adapter COMMS-KIT-01	Installed at the IQ Envoy. For communications with Enphase Encharge™ storage and Enphase Enpower™ smart switch. Includes USB cable for connection to IQ Envoy or Enphase IQ Combiner™ and allows redundant wireless communication with Encharge and Enpower.
Circuit Breakers BRK-10A-2-240 BRK-15A-2-240 BRK-20A-2P-240	Supports Eaton BR210, BR215, BR220, BR230, BR240, BR250, and BR260 circuit breakers. Circuit breaker, 2 pole, 10A, Eaton BR210 Circuit breaker, 2 pole, 15A, Eaton BR215 Circuit breaker, 2 pole, 20A, Eaton BR220
EPLC-01	Power line carrier (communication bridge pair), quantity - one pair
XA-PLUG-120-3	Accessory receptacle for Power Line Carrier in IQ Combiner 3 (required for EPLC-01)
XA-ENV-PCBA-3	Replacement IQ Envoy printed circuit board (PCB) for Combiner 3
ELECTRICAL SPECIFICATIONS	
Rating	Continuous duty
System voltage	120/240 VAC, 60 Hz
Eaton BR series busbar rating	125 A
Max. continuous current rating (output to grid)	65 A
Max. fuse/circuit rating (output)	90 A
Branch circuits (solar and/or storage)	Up to four 2-pole Eaton BR series Distributed Generation (DG) breakers only (not included)
Max. continuous current rating (input from PV)	64 A
Max. total branch circuit breaker rating (input)	80A of distributed generation / 90A with IQ Envoy breaker included
Production Metering CT	200 A solid core pre-installed and wired to IQ Envoy
MECHANICAL DATA	
Dimensions (WxHxD)	49.5 x 37.5 x 16.8 cm (19.5” x 14.75” x 6.63”). Height is 21.06" (53.5 cm with mounting brackets).
Weight	7.5 kg (16.5 lbs)
Ambient temperature range	-40° C to +46° C (-40° to 115° F)
Cooling	Natural convection, plus heat shield
Enclosure environmental rating	Outdoor, NRTL-certified, NEMA type 3R, polycarbonate construction
Wire sizes	• 20 A to 50 A breaker inputs: 14 to 4 AWG copper conductors • 60 A breaker branch input: 4 to 1/0 AWG copper conductors • Main lug combined output: 10 to 2/0 AWG copper conductors • Neutral and ground: 14 to 1/0 copper conductors Always follow local code requirements for conductor sizing.
Altitude	To 2000 meters (6,560 feet)
INTERNET CONNECTION OPTIONS	
Integrated Wi-Fi	802.11b/g/n
Ethernet	Optional, 802.3, Cat5E (or Cat 6) UTP Ethernet cable (not included)
Cellular	Optional, CELLMODEM-01 (3G) or CELLMODEM-03 (4G) or CELLMODEM-M1 (4G based LTE-M) (not included)
COMPLIANCE	
Compliance, Combiner	UL 1741, CAN/CSA C22.2 No. 107.1, 47 CFR, Part 15, Class B, ICES 003 Production metering: ANSI C12.20 accuracy class 0.5 (PV production)
Compliance, IQ Envoy	UL 60601-1/CANCSA 22.2 No. 61010-1

To learn more about Enphase offerings, visit **enphase.com**

2019-11-04

BLUE RAVEN SOLAR
1403 N RESEARCH WAY, BUILDING J
OREM, UT 84097
800-377-4480
WWW.BLUERAVENSOLAR.COM

NABCEP CERTIFIED
PV INSTALLATION PROFESSIONAL
Scott Gurney
PV-011719-015866

CONTRACTOR:
BRS FIELD OPS
385.498.6700

SHEET NAME
SPEC SHEET

PAGE NUMBER	REVISION
SS	0

REC
SOLAR'S MOST TRUSTED

REC ALPHA PURE SERIES > PRODUCT SPECIFICATIONS

PRODUCT SPECIFICATIONS

GENERAL DATA

Cell type:	132 half-cut REC heterojunction cells with lead-free, gapless technology 6 strings of 22 cells in series
Glass:	0.13 in (3.2 mm) solar glass with anti-reflection surface treatment
Backsheet:	Highly resistant polymer (black)
Frame:	Anodized aluminum (black)
Junction box:	3-part, 3 bypass diodes, IP68 rated in accordance with IEC 62790
Connectors:	Stäubli MC4 PV-KBT4/KST4, 12 AWG (4 mm²) in accordance with IEC 62852 IP68 only when connected
Cable:	12 AWG (4 mm²) PV wire, 43+47 in (1.1+1.2 m) accordance with EN 50618
Dimensions:	71.7 x 40 x 1.2 in (1821 x 1016 x 30 mm)
Weight:	45 lbs (20.5 kg)
Origin:	Made in Singapore

ELECTRICAL DATA

	Product Code*: RECxxxAA Pure				
STC					
Power Output - P_{MAX} (Wp)	385	390	395	400	405
Watt Class Sorting - (W)	0/+5	0/+5	0/+5	0/+5	0/+5
Nominal Power Voltage - V_{MPP} (V)	41.2	41.5	41.8	42.1	42.4
Nominal Power Current - I_{MPP} (A)	9.35	9.40	9.45	9.51	9.56
Open Circuit Voltage - V_{OC} (V)	48.5	48.6	48.7	48.8	48.9
Short Circuit Current - I_{SC} (A)	10.10	10.15	10.20	10.25	10.30
Power Density (W/sq ft)	19.3	19.6	19.8	20.1	20.3
Panel Efficiency (%)	20.8	21.1	21.3	21.6	21.9
NMOT					
Power Output - P_{MAX} (Wp)	293	297	301	305	309
Nominal Power Voltage - V_{MPP} (V)	38.8	39.1	39.4	39.7	40.0
Nominal Power Current - I_{MPP} (A)	7.55	7.59	7.63	7.68	7.72
Open Circuit Voltage - V_{OC} (V)	45.7	45.8	45.9	46.0	46.1
Short Circuit Current - I_{SC} (A)	8.16	8.20	8.24	8.28	8.32

Values at standard test conditions (STC: air mass AM 1.5, irradiance 10.75 W/sq ft (1000 W/m²), temperature 77°F (25°C), based on a production spread with a tolerance of P_{MAX}, V_{OC} & I_{SC} ±3% within one watt class. Nominal module operating temperature (NMOT: air mass AM 1.5, irradiance 800 W/m², temperature 68°F (20°C), windspeed 3.3 ft/s (1 m/s). * Where xxx indicates the nominal power class (P_{MAX}) at STC above.

IEC 61215:2016, IEC 61730:2016, UL 61730	
IEC 62804	PID
IEC 61701	Salt Mist
IEC 62716	Ammonia Resistance
UL 61730	Fire Type Class 2
IEC 62782	Dynamic Mechanical Load
IEC 61215-2:2016	Hailstone (35mm)
IEC 62321	Lead-free acc. to RoHS EU 863/2015

ISO 14001:2004, ISO 9001:2015, OHSAS 18001:2007, IEC 62941

	Standard	REC ProTrust	
Installed by an REC Certified Solar Professional	No	Yes	Yes
System Size	All	<25 kW	25-500 kW
Product Warranty (yrs)	20	25	25
Power Warranty (yrs)	25	25	25
Labor Warranty (yrs)	0	25	10
Power in Year 1	98%	98%	98%
Annual Degradation	0.25%	0.25%	0.25%
Power in Year 25	92%	92%	92%

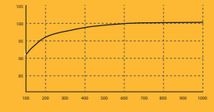
See warranty documents for details. Conditions apply

Operational temperature:	-40 ... +185°F (-40 ... +85°C)
Maximum system voltage:	1000 V
Maximum test load (front):	+7000 Pa (146 lbs/sq ft)*
Maximum test load (rear):	-4000 Pa (83.5 lbs/sq ft)*
Max series fuse rating:	25 A
Max reverse current:	25 A

*See installation manual for mounting instructions. Design load = Test load / 1.5 (safety factor)

Nominal Module Operating Temperature:	44°C (±2°C)
Temperature coefficient of P_{MAX}:	-0.26 %/°C
Temperature coefficient of V_{OC}:	-0.24 %/°C
Temperature coefficient of I_{SC}:	0.04 %/°C

*The temperature coefficients stated are linear values



BLUE RAVEN SOLAR

1403 N RESEARCH WAY, BUILDING J
OREM, UT 84097

800-377-4480
WWW.BLUERAVENSOLAR.COM

NABCEP CERTIFIED
PV INSTALLATION PROFESSIONAL
Scott Gurney
PV-011719-015866

CONTRACTOR:
BRS FIELD OPS
385.498.6700

SHEET NAME
SPEC SHEET

PAGE NUMBER
SS

REVISION
0

Product data sheet
Characteristics

DU221RB
Safety switch, general duty, non fusible, 30A, 2 poles, 3 hp, 240 VAC, NEMA 3R, bolt-on provision

Product availability : Stock - Normally stocked in distribution facility

Price* : 177.00 USD

Main

Product	Single Throw Safety Switch
Current Rating	30 A
Certifications	UL listed file E2875
Enclosure Rating	NEMA 3R
Disconnect Type	Non-fusible disconnect switch
Factory Installed Neutral	None
Mounting Type	Surface
Number of Poles	2
Electrical Connection	Lugs
Duty Rating	General duty
Voltage Rating	240 V AC
Wire Size	AWG 14...AWG 6 copper AWG 12...AWG 6 aluminium

Complementary

Short-circuit withstand	200 kA
Maximum Horse Power Rating	3 hp 240 V AC 60 Hz 1 phase NEC 430.52
Tightening torque	30 lbf.in (3.39 N.m) 0.00...0.02 in² (2.08...13.3 mm²) AWG 14...AWG 6)
Height	9.63 in (244.60 mm)
Width	7.75 in (196.85 mm)
Depth	3.75 in (95.25 mm)

* Price is "List Price" and may be subject to a trade discount – check with your local distributor or retailer for actual price.

Apr 21, 2021

Ordering and shipping details

Category	00106 - D & DU SW,NEMA3R, 30-200A
Discount Schedule	DE1A
GTIN	00785901490340
Nbr. of units in pkg.	1
Package weight(Lbs)	4.65 lb(US) (2.11 kg)
Returnability	Yes
Country of origin	MX

Packing Units

Unit Type of Package 1	PCE
Package 1 Height	5.40 in (13.716 cm)
Package 1 width	7.80 in (19.812 cm)
Package 1 Length	9.90 in (25.146 cm)
Unit Type of Package 2	CAR
Number of Units in Package 2	5
Package 2 Weight	24.60 lb(US) (11.158 kg)
Package 2 Height	10.80 in (27.432 cm)
Package 2 width	10.50 in (26.67 cm)
Package 2 Length	23.80 in (60.452 cm)
Unit Type of Package 3	PAL
Number of Units in Package 3	160
Package 3 Weight	814.00 lb(US) (369.224 kg)
Package 3 Height	46.50 in (118.11 cm)
Package 3 width	40.00 in (101.6 cm)
Package 3 Length	48.00 in (121.92 cm)

Offer Sustainability

Sustainable offer status	Green Premium product
California proposition 65	WARNING: This product can expose you to chemicals including: Lead and lead compounds, which is known to the State of California to cause cancer and birth defects or other reproductive harm. For more information go to www.P65Warnings.ca.gov
REACh Regulation	REACh Declaration
REACh free of SVHC	Yes
EU RoHS Directive	Compliant EU RoHS Declaration
Toxic heavy metal free	Yes
Mercury free	Yes
RoHS exemption information	Yes
China RoHS Regulation	China RoHS declaration Pro-active China RoHS declaration (out of China RoHS legal scope)
Environmental Disclosure	Product Environmental Profile
PVC free	Yes

Contractual warranty

Warranty	18 months

BLUE RAVEN SOLAR
1403 N. Research Way
Orem, UT 84097

800.377.4480
WWW.BLUERAVENSOLAR.COM

NABCEP CERTIFIED
PV INSTALLATION PROFESSIONAL
Scott Gurney
#PV-011719-015866

CONTRACTOR:
BRS FIELD OPS
385-498-6700

SHEET NAME:
SPEC SHEETS

REVISION:	PAGE NUMBER:
0	SS

JB-1

Specification Sheet

PV Junction Box for Composition/Asphalt Shingle Roofs

A. System Specifications and Ratings

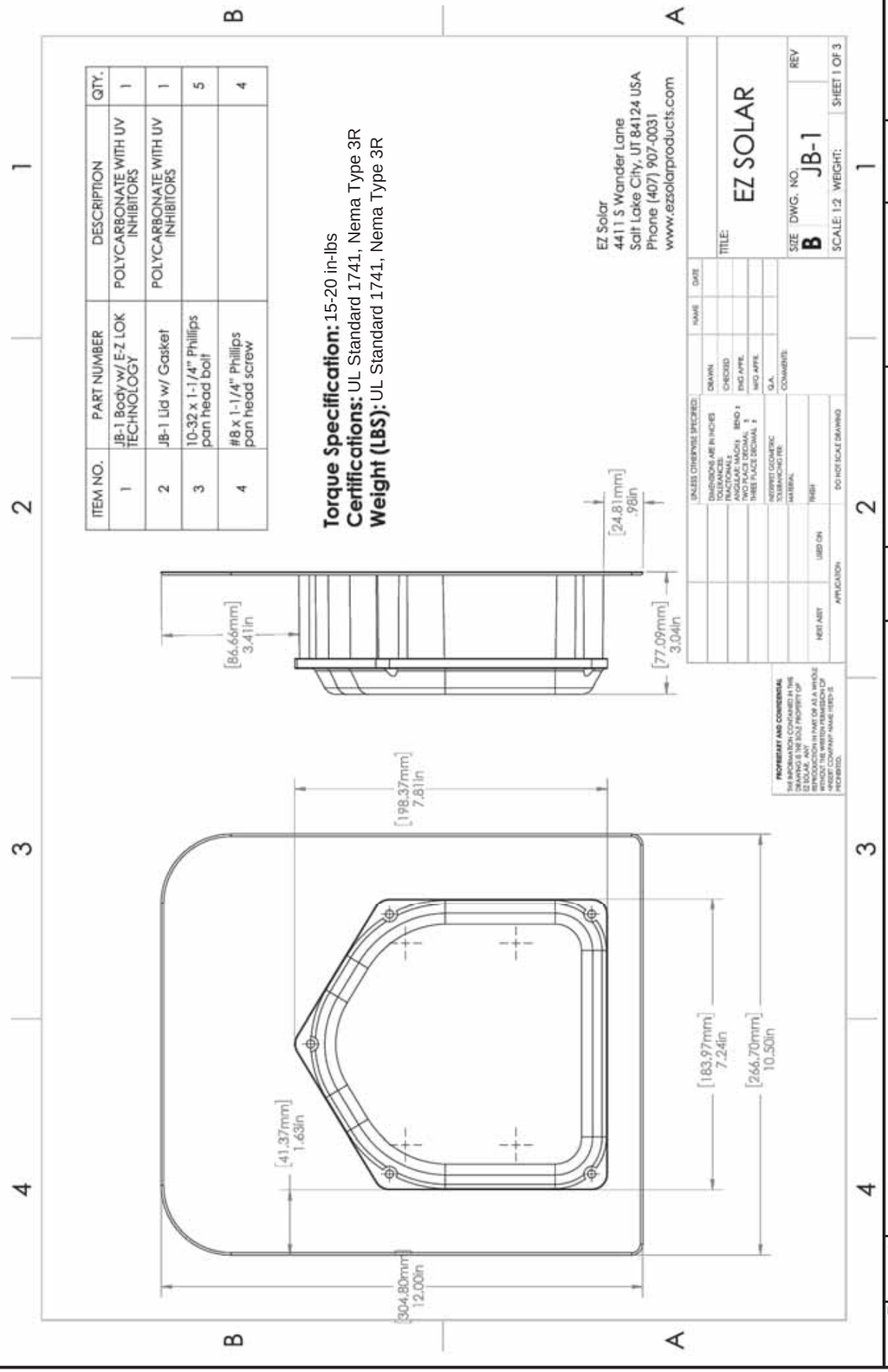
- Maximum Voltage: 600 Volts
- Maximum Current: 60 Amps
- Allowable Wire: 14 AWG – 6 AWG
- Spacing: Please maintain a spacing of at least ½" between uninsulated live parts and fittings for conduit, armored cable, and uninsulated lie parts of opposite polarity.
- Enclosure Rating: Type 3R
- Roof Slope Range: 2.5 – 12:12
- Max Side Wall Fitting Size: 1"
- Max Floor Pass-Through Fitting Size: 1"
- Ambient Operating Conditions: -35°C - +75°C
- Compliance:
  - JB-1: UL1741
  - Approved wire connectors: must conform to UL1741
- System Marking: **Intertek Symbol and File # 5015705**
- Periodic Re-inspections: If re-inspections yield loose components, loose fasteners, or any corrosion between components, components that are found to be affected are to be replaced immediately.

Table 1: Typical Wire Size, Torque Loads and Ratings

	1 Conductor	2 Conductor	Torque				
			Type	NM	Inch Lbs	Voltage	Current
ABB ZS6 terminal block	10-24 awg	16-24 awg	Sol/Str	0.5-0.7	6.2-8.85	600V	30 amp
ABB ZS10 terminal block	6-24 awg	12-20 awg	Sol/Str	1.0-1.6	8.85-14.16	600V	40 amp
ABB ZS16 terminal bock	4-24 awg	10-20 awg	Sol/Str	1.6-2.4	14.6-21.24	600V	60 amp
ABB M6/8 terminal block	8-22 awg		Sol/Str	.08-1	8.85	600V	50 amp
Ideal 452 Red WING-NUT Wire Connector	8-18 awg		Sol/Str			600V	
Ideal 451 Yellow WING-NUT Wire Connector	10-18 awg		Sol/Str			600V	
Ideal, In-Sure Push-In Connector Part #39	10-14 awg		Sol/Str			600V	
International Hydraulics 2S2/0	10-14 awg		Sol/Str	4	35		
	8 awg		Sol/Str	4.5	40		
Brumall 4-5,3	4-6 awg		Sol/Str		45	2000V	
	10-14 awg		Sol/Str		35		
Blackburn LL414	4-14 awg		Sol/Str				

Table 2: Minimum wire-bending space for conductors through a wall opposite terminals in mm (inches)

Wire size, AWG or		Wires per terminal (pole)							
		1		2		3		4 or More	
kcmil	(mm2)	mm	(inch)	mm	(inch)	mm	(inch)	mm	(inch)
14-10	(2.1-5.3)	Not specified		-		-		-	
8	(8.4)	38.1	(1-1/2)	-		-		-	
6	(13.3)	50.8	(2)	-		-		-	



BLUE RAVEN SOLAR

1403 N. Research Way
Orem, UT 84097

800.377.4480
WWW.BLUERAVENSOLAR.COM

NABCEP CERTIFIED

PV INSTALLATION PROFESSIONAL
Scott Gurney
#PV-011719-015866

CONTRACTOR:
BRS FIELD OPS
385-498-6700

SHEET NAME:
SPEC SHEETS

REVISION: 0

PAGE NUMBER: SS

Carlon®

Carlon® Non-Metallic Junction Boxes

Molded Non-Metallic Junction Boxes — 6P Rated

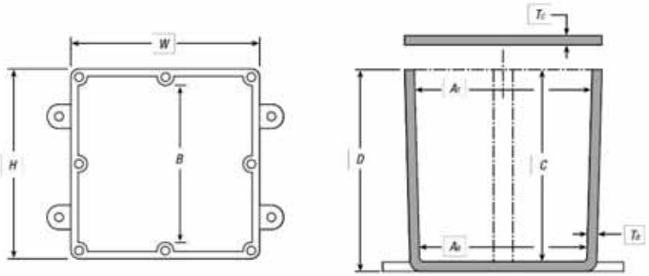
Non-metallic junction boxes are UL® Listed with a NEMA 6P rating per Section 314.28 of the National Electrical Code® and CSA Certified per Section 12 of the Canadian Electrical Code. Manufactured from PVC or PPO thermoplastic molding compound and featuring foam-in-place gasketed lids attached with stainless steel screws, these rugged enclosures offer all the corrosion resistance and physical properties you need for direct burial applications.

Type 6P enclosures are intended for indoor or outdoor use, primarily to provide a degree of protection against contact with enclosed equipment, falling dirt, hose-directed water, entry of water during prolonged submersion at a limited depth and external ice formation.

- All Carlon® Junction Boxes are UL® Listed/CSA Certified and maintain a minimum of a NEMA Type 4/4x Rating
- Part numbers with an asterisk (*) are UL® Listed and maintain a NEMA Type 6P Rating and Type 4/4X Rating

Except where noted by †

LISTED E11461



CAT. NO.	SIZE (IN.) H x W x D	STD. CTN.	DIMENSIONS (IN.) MIN Ar	MIN Ab	MIN B	MIN C	Ts	Tc	MATERIAL PVC	MATERIAL THERMO-PLASTIC	STD. WT. (LBS.)
E989NNJ*	4 x 4 x 2	10	3 1/4	3 1/8	N/A	2	.160	.155	X		3
E987N*	4 x 4 x 4	10	3 1/4	3 1/2	N/A	4	.160	.155	X		4
E989NNR* †	4 x 4 x 6	10	3 1/4	3 1/8	N/A	6	.160	.200	X		5
E989PPJ*	5 x 5 x 2	10	4 1/16	4 1/2	N/A	2	.110	.150		X	3
E987R-CAR*	6 x 6 x 4	2	6	5 1/8	N/A	4	.190	.190		X	3
E989RRR-UPC*	6 x 6 x 6	8	5 1/8	5 1/8	N/A	6	.160	.150		X	14
E989N-CAR	8 x 8 x 4	1	8	8	N/A	4	.185	.190		X	2
E989SSX-UPC	8 x 8 x 7	2	7 15/16	7 3/4	N/A	7	.160	.150		X	6
E989UUN	12 x 12 x 4	3	11 1/8	11 1/2	11 1/8	4	.160	.150		X	12
E989R-UPC	12 x 12 x 6	2	11 13/16	11 1/8	11 1/16	6	.265	.185		X	10

* UL Listed

† Not CSA Certified

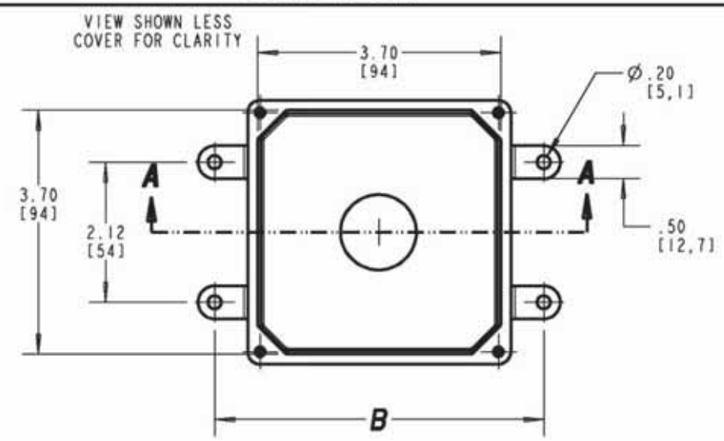
www.tnb.com

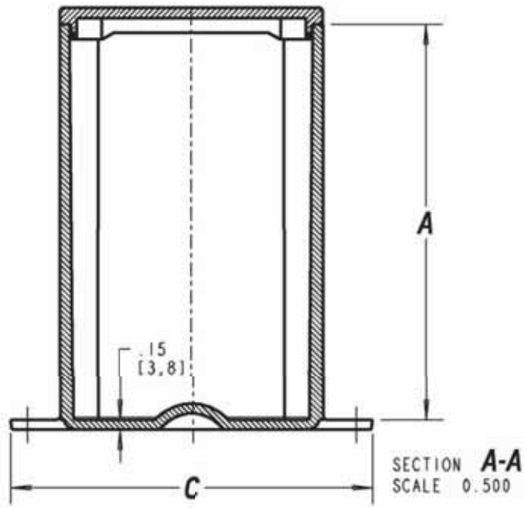
United States
Tel: 901.252.8000
800.816.7809
Fax: 901.252.1354

Technical Services
Tel: 888.862.3289

Thomas&Betts

Carlon®





SIZE	A	B	C
E989NNJ E989NNJB E989NNJ-CAR E989NNJCL E989NNJL (4X4X2)	2.00 (50,8)	4.63 (117,6)	5.13 (130,2)
E989NNR E989NNR-CAR (4X4X6)	6.00 (152.4)	5.00 (127,0)	5.50 (139,7)

NOTES:
1. MATERIAL: PVC
2. NEMA TYPES: 4/4X, 6P

SECTION A-A
SCALE 0.500

GENERAL NOTES
1. ALL DIMENSIONS ARE FOR REFERENCE ONLY.
2. DIMENSIONS IN BRACKETS [ ] ARE IN METRIC UNITS.

REVISIONS
F SEE ERN 2016195 FOR APPROVAL SIGNATURES & RELEASE DATE. PROJECT NO: 5AM000006

Thomas&Betts www.tnb.com

DESCRIPTION: MOLDED NON-METALLIC ENCLOSURE

ORIGINAL PROJECT NO / (ERN NO)	SHEET NO:	REV. NO:	DRAWING NO:
/ ( )	2 OF 2	F	WSD-AC01977

BLUE RAVEN SOLAR

1403 N. Research Way
Orem, UT 84097

800.377.4480
WWW.BLUERAVENSOLAR.COM

NABCEP CERTIFIED
PV INSTALLATION PROFESSIONAL
Scott Gurney
#PV-011719-015866

CONTRACTOR:
BRS FIELD OPS
385-498-6700

SHEET NAME:
SPEC SHEETS

REVISION: 0

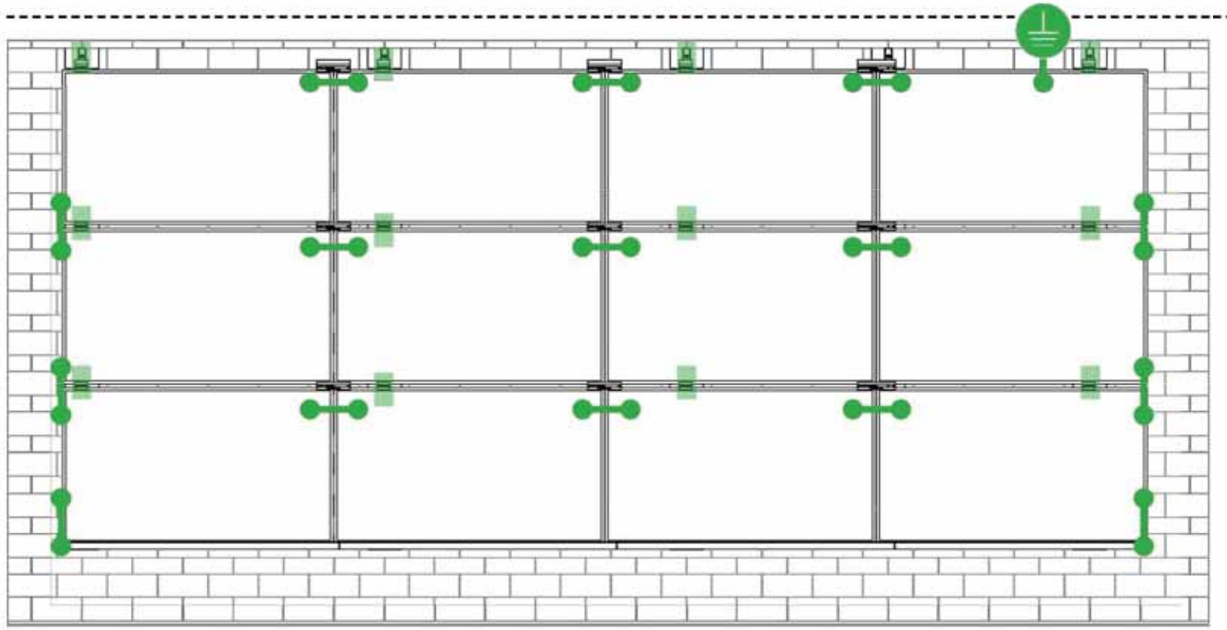
PAGE NUMBER: SS

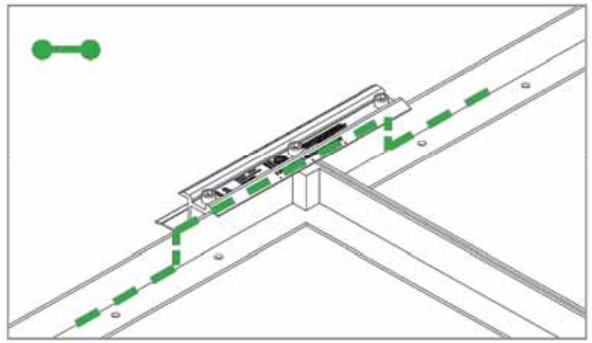
SFM SUN FRAME MICRORAIL™

SYSTEM BONDING & GROUNDING

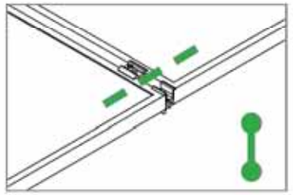
INSTALLATION GUIDE

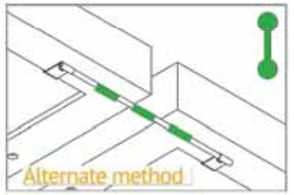
Q PAGE



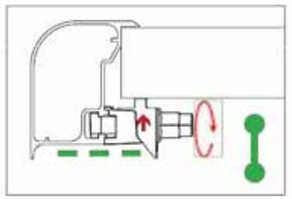


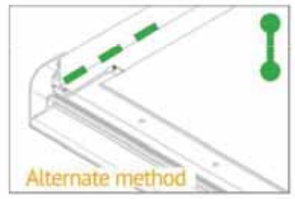
E-W BONDING PATH:
E-W module to module bonding is accomplished with 2 pre-installed bonding pins which engage on the secure side of the MicrorailTM and splice.





N-S BONDING PATH:
N-S module to module bonding is accomplished with bonding clamp with 2 integral bonding pins. (refer also to alternate method)





TRIMRAIL BONDING PATH:
Trimrail to module bonding is accomplished with bonding clamp with integral bonding pin and bonding T-bolt. (refer also to alternate method)

Star Washer is Single Use Only

TERMINAL TORQUE, Install Conductor and torque to the following:
4-6 AWG: 35in-lbs
8 AWG: 25 in-lbs
10-14 AWG: 20 in-lbs

TERMINAL TORQUE, Install Conductor and torque to the following:
4-14 AWG: 35in-lbs

WEEBLUG Single Use Only

TERMINAL TORQUE, Install Conductor and torque to the following:
6-14 AWG: 7ft-lbs

LUG DETAIL & TORQUE INFO
Ilsco Lay-In Lug (GBL-4DBT)
- 10-32 mounting hardware
- Torque = 5 ft-lb
- AWG 4-14 - Solid or Stranded

LUG DETAIL & TORQUE INFO
Ilsco Flange Lug(SGB-4)
- 1/4" mounting hardware
- Torque = 75 in-lb
- AWG 4-14 - Solid or Stranded

LUG DETAIL & TORQUE INFO
Wiley WEEBLug (6.7)
- 1/4" mounting hardware
- Torque = 10 ft-lb
- AWG 6-14 - Solid or Stranded

NOTE: ISOLATE COPPER FROM ALUMINUM CONTACT TO PREVENT CORROSION

System bonding is accomplished through modules. System grounding accomplished by attaching a ground lug to any module at a location on the module specified by the module manufacturer.

BLUE RAVEN SOLAR

1403 N. Research Way
Orem, UT 84097

800.377.4480
WWW.BLUERAVENSOLAR.COM

NABCEP CERTIFIED
PV INSTALLATION PROFESSIONAL
Scott Gurney
#PV-011719-015866

CONTRACTOR:
BRS FIELD OPS
385-498-6700

SHEET NAME:
SPEC SHEETS

REVISION: 0

PAGE NUMBER: SS

SFM SUN FRAME MICRORAIL™

UL CODE COMPLIANCE NOTES R

INSTALLATION GUIDE PAGE

SYSTEM LEVEL FIRE CLASSIFICATION

The system fire class rating requires installation in the manner specified in the SUNFRAME MICRORAIL (SFM) Installation Guide. SFM has been classified to the system level fire portion of UL 1703. This UL 1703 classification has been incorporated into the UL 2703 product certification. SFM has achieved Class A, B & C system level performance for low slope & steep sloped roofs when used in conjunction with type 1 and type 2 modules. Class A, B & C system level fire performance is inherent in the SFM design, and no additional mitigation measures are required. The fire classification rating is valid for any roof pitch. There is no required minimum or maximum height limitation above the roof deck to maintain the Class A, B & C fire rating for SFM. SUNFRAME MICRORAIL™ components shall be mounted over a fire resistant roof covering rated for the application.

Module Type	Roof Slope	System Level Fire Rating	Microrail Direction	Module Orientation	Mitigation Required
Type 1 and Type 2	Steep Slope & Low Slope	Class A, B & C	East-West	Landscape OR Portrait	None Required

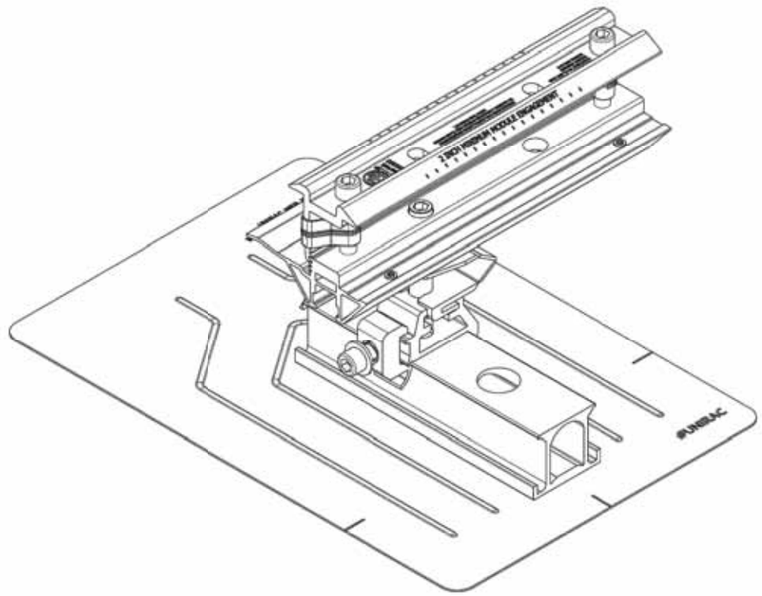
UL2703 TEST MODULES

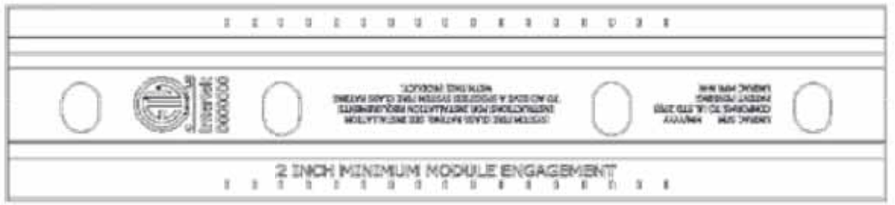
See page "S" for a list of modules that were electrically and mechanically tested or qualified with the SUNFRAME MICRORAIL (SFM) components outlined within this Installation Guide.

- Maximum Area of Module = 22.3 sqft
- UL2703 Design Load Ratings:
  - a) Downward Pressure – 113 PSF / 5400 Pa
  - b) Upward Pressure – 50 PSF / 2400 Pa
  - c) Down-Slope Load – 30 PSF / 1400 Pa
- Tested Loads:
  - a) Downward Pressure – 170 PSF / 8000 Pa
  - b) Upward Pressure – 75 PSF / 3500 Pa
  - c) Down-Slope Load – 45 PSF / 2100 Pa
- Maximum Span = 6ft
- Use with a maximum over current protection device OCPD of 30A
- System conforms to UL Std 2703, certified to LTR AE-001-2012
- Rated for a design load of 2400 Pa / 5400 Pa with 24 inch span

LABEL MARKINGS

- System fire class rating: See installation instructions for installation requirements to achieve a specified system fire class rating with Unirac .
- Unirac SUNFRAME MICRORAIL™ is listed to UL 2703.
- All splices within a system are shipped with marking indicating date and location of manufacture.





BLUE RAVEN SOLAR
1403 N. Research Way
Orem, UT 84097
800.377.4480
WWW.BLUERAVENSOLAR.COM

NABCEP CERTIFIED
PV INSTALLATION PROFESSIONAL
Scott Gurney
#PV-011719-015866

CONTRACTOR:
BRS FIELD OPS
385-498-6700

SHEET NAME:
SPEC SHEETS

REVISION: 0

PAGE NUMBER: SS

SFM SUN FRAME MICRORAIL™ — TESTED / CERTIFIED MODULE LIST — INSTALLATION GUIDE — S PAGE

Manufacture	Module Model / Series
Aleo	P-Series
Astronergy	CHSM6612P, CHSM6612P/HV, CHSM6612M, CHSM6612M/HV, CHSM6610M (BL)(BF)/(HF), CHSM72M-HC
Auxin	AXN6M610T, AXN6P610T, AXN6M612T & AXN6P612T
Axitec	AXIblackpremium 60 (35mm), AXIpower 60 (35mm), AXIpower 72 (40mm), AXIpremium 60 (35mm), AXIpremium 72 (40mm).
Aptos	DNA-120-MF26 DNA-144-MF26
Boviet	BVM6610, BVM6612
BYD	P6K & MHK-36 Series
Canadian Solar	CS6V-M, CS6P-P, CS6K-M, CS5A-M, CS6K-MS, CS6U-P, CS6U-M, CS6X-P, CS6K-MS, CS6K-M, CS6K-P, CS6P-P, CS6P-M, CS3U-P, CS3U-MS, CS3K-P, CS3K-MS, CS1K-MS, CS3K, CS3U, CS3U-MB-AG, CS3K-MB-AG, CS6K, CS6U, CS3L, CS3W, CS1H-MS, CS1U-MS
Centrosolar America	C-Series & E-Series
CertainTeed	CT2xxMxx-01, CT2xxPxx-01, CTxxxMxx-02, CTxxxM-03, CTxxxMxx-04, CTxxxHC11-04
Dehui	DH-60M
Eco Solargy	Orion 1000 & Apollo 1000
FreeVolt	Mono PERC
GCL	GCL-P6 & GCL-M6 Series

Manufacture	Module Model / Series
Hansol	TD-AN3, TD-AN4, UB-AN1, UD-AN1
Heliene	36M, 60M, 60P, 72M & 72P Series
HT Solar	HT60-156(M) (NDV) (-F), HT 72-156(M/P)
Hyundai	KG, MG, TG, RI, RG, TI, MI, HI & KI Series
ITEK	iT, iT-HE & iT-SE Series
Japan Solar	JPS-60 & JPS-72 Series
JA Solar	JAP6 60-xxx, JAM6-60-xxx/SI, JAM6(K)-60/xxx, JAP6(k)-72-xxx/4BB, JAP72SYY-xxx/ZZ, JAP6(k)-60-xxx/4BB, JAP60SYY-xxx/ZZ, JAM6(k)-72-xxx/ZZ, JAM72SYY-xxx/ZZ, JAM6(k)-60-xxx/ZZ, JAM60SYY-xxx/ZZ. i. YY: 01, 02, 03, 09, 10 ii. ZZ: SC, PR, BP, HiT, IB, MW
Jinko	JKM & JKMS Series
Kyocera	KU Series
LG Electronics	LGxxxN2T-A4 LGxxx(A1C/E1C/E1K/N1C/N1K/N2T/N2W/Q1C/Q1K/S1C/S2W)-A5 LGxxx(A1C/M1C/M1K/N1C/N1K/Q1C/Q1K/QAC/QAK)-A6 LGxxx(N2T/N2W)-E6 LGxxx(N1C/N1K/N2W/S1C/S2W)-G4 LGxxxN2T-J5 LGxxx(N1K/N2T/N2W)-L5 LGxxx(N1C/Q1C/Q1K)-N5 LGxxx (N1C/N1K/N2W/Q1C/Q1K)-V5

Manufacture	Module Model / Series
LONGi	LR4-60(HIB/HIH/HPB/HPH)-xxxM LR4-72(HIH/HPH)-xxxM LR6-60(BP/HBD/HIBD)-xxxM (30mm) LR6-60(BK)(PE)(HPB)(HPH)-xxxM (35mm) LR6-60(BK)(PE)(PB)(PH)-xxxM (40mm) LR6-72(BP)(HBD)(HIBD)-xxxM (30mm) LR6-72(HV)(BK)(PE)(PH)(PB)(HPH)-xxxM (35mm) LR6-72(BK)(HV)(PE)(PB)(PH)-xxxM (40mm)
Mission Solar Energy	MSE Series
Mitsubishi	MJE & MLE Series
Neo Solar Power Co.	D6M & D6P Series
Panasonic	VBHNxxxSA15 & SA16, VBHNxxxSA17 & SA18, VBHNxxxSA17(E/G) & SA18E, VBHNxxxKA01 & KA03 & KA04, VBHNxxxZA01, VBHNxxxZA02, VBHNxxxZA03, VBHNxxxZA04
Peimar	SGxxxM (FB/BF)
Phono Solar	PS-60, PS-72
Q.Cells	Plus, Pro, Peak, G3, G4, G5, G6(+), G7, G8(+) Pro, Peak L-G2, L-G4, L-G5, L-G6, L-G7
REC	Alpha (72) (Black) N-Peak (Black) PEAK Energy Series PEAK Energy BLK2 Series PEAK Energy 72 Series TwinPeak Series TwinPeak 2 Series TwinPeak 2 BLK2 Series TwinPeak 2S(M)72(XV) TwinPeak 3 Series (38mm)

Please see the SFM UL2703Construction Data Report at Unirac.com to ensure the exact solar module selected is approved for use with SFM.
SFM Infinity is not compatible with module frame height of less than 30mm and more than 40mm. See page J for further information.

BLUE RAVEN SOLAR
1403 N. Research Way
Orem, UT 84097
800.377.4480
WWW.BLUERAVENSOLAR.COM

NABCEP CERTIFIED
PV INSTALLATION PROFESSIONAL
Scott Gurney
#PV-011719-015866

CONTRACTOR:
BRS FIELD OPS
385-498-6700

SHEET NAME: SPEC SHEETS
REVISION: 0
PAGE NUMBER: SS

intertek
Total Quality. Assured.

AUTHORIZATION TO MARK

This authorizes the application of the Certification Mark(s) shown below to the models described in the Product(s) Covered section when made in accordance with the conditions set forth in the Certification Agreement and Listing Report. This authorization also applies to multiple listee model(s) identified on the correlation page of the Listing Report.

This document is the property of Intertek Testing Services and is not transferable. The certification mark(s) may be applied only at the location of the Party Authorized To Apply Mark.

Applicant:	Unirac, Inc	**Manufacturer:**	
Address:	1411 Broadway Blvd NE Albuquerque, NM 87102	**Address:**	
Country:	USA	**Country:**	
Contact:	Klaus Nicolaedis Todd Ganshaw	**Contact:**	
Phone:	505-462-2190 505-843-1418	**Phone:**	
FAX:	NA	**FAX:**	
Email:	klaus.nicolaedis@unirac.com toddg@unirac.com	**Email:**	

Party Authorized To Apply Mark: Same as Manufacturer
Report Issuing Office: Lake Forest, CA

Control Number: 5003705 **Authorized by:** for L. Matthew Snyder, Certification Manager

This document supersedes all previous Authorizations to Mark for the noted Report Number.

Intertek Testing Services NA Inc.
545 East Algonquin Road, Arlington Heights, IL 60005
Telephone 800-345-3851 or 847-439-5667 Fax 312-283-1672

Standard(s):	Mounting Systems, Mounting Devices, Clamping/Retention Devices, and Ground Lugs for Use with Flat-Plate Photovoltaic Modules and Panels [UL 2703: 2015 Ed.1] Photovoltaic Module Racking Systems [CSA LTR AE-001:2012]
Product:	Photovoltaic Mounting System, Sun Frame Microrail Installation Guide, PUB2021JAN13
Brand Name:	Unirac
Models:	Unirac SFM

intertek
Total Quality. Assured.

AUTHORIZATION TO MARK

This authorizes the application of the Certification Mark(s) shown below to the models described in the Product(s) Covered section when made in accordance with the conditions set forth in the Certification Agreement and Listing Report. This authorization also applies to multiple listee model(s) identified on the correlation page of the Listing Report.

This document is the property of Intertek Testing Services and is not transferable. The certification mark(s) may be applied only at the location of the Party Authorized To Apply Mark.

Applicant:	Unirac, Inc	**Manufacturer:**	
Address:	1411 Broadway Blvd NE Albuquerque, NM 87102	**Address:**	
Country:	USA	**Country:**	
Contact:	Klaus Nicolaedis Todd Ganshaw	**Contact:**	
Phone:	505-462-2190 505-843-1418	**Phone:**	
FAX:	NA	**FAX:**	
Email:	klaus.nicolaedis@unirac.com toddg@unirac.com	**Email:**	

Party Authorized To Apply Mark: Same as Manufacturer
Report Issuing Office: Lake Forest, CA

Control Number: 5014989 **Authorized by:** for L. Matthew Snyder, Certification Manager

This document supersedes all previous Authorizations to Mark for the noted Report Number.

This Authorization to Mark is for the exclusive use of Intertek's Client and is provided pursuant to the Certification agreement between Intertek and its Client. Intertek's responsibility and liability are limited to the terms and conditions of the agreement. Intertek assumes no liability to any party, other than to the Client in accordance with the agreement, for any loss, expense or damage occasioned by the use of this Authorization to Mark. Only the Client is authorized to permit copying or distribution of this Authorization to Mark and then only in its entirety. Use of Intertek's Certification mark is restricted to the conditions laid out in the agreement and in this Authorization to Mark. Any further use of the Intertek name for the sale or advertisement of the tested material, product or service must first be approved in writing by Intertek. Initial Factory Assessments and Follow up Services are for the purpose of assuring appropriate usage of the Certification mark in accordance with the agreement, they are not for the purposes of production quality control and do not relieve the Client of their obligations in this respect.

Intertek Testing Services NA Inc.
545 East Algonquin Road, Arlington Heights, IL 60005
Telephone 800-345-3851 or 847-439-5667 Fax 312-283-1672

Standard(s):	Mounting Systems, Mounting Devices, Clamping/Retention Devices, and Ground Lugs for Use with Flat-Plate Photovoltaic Modules and Panels [UL 2703: 2015 Ed.1] Photovoltaic Module Racking Systems [CSA LTR AE-001:2012]
Product:	Photovoltaic Mounting System, Sun Frame Microrail Installation Guide, PUB2021JAN13
Brand Name:	Unirac
Models:	Unirac SFM

ATM for Report 102393982LAX-002 Page 2 of 3 ATM Issued: 13-May-2021
ED 16.3.15 (15-Oct-20) Mandatory

BLUE RAVEN SOLAR
1403 N. Research Way
Orem, UT 84097

800.377.4480
WWW.BLUERAVENSOLAR.COM

NABCEP CERTIFIED
PV INSTALLATION PROFESSIONAL
Scott Gurney
#PV-011719-015866

CONTRACTOR:
BRS FIELD OPS
385-498-6700

SHEET NAME:
SPEC SHEETS

REVISION:	PAGE NUMBER:
0	SS

intertek
Total Quality. Assured.

Listing Constructional Data Report (CDR)

1.0 Reference and Address			
Report Number	102393982LAX-002	Original 11-Apr-2016	Revised: 18-Jan-2021
Standard(s)	Mounting Systems, Mounting Devices, Clamping/Retention Devices, and Ground Lugs for Use with Flat-Plate Photovoltaic Modules and Panels [UL 2703: 2015 Ed.1] Photovoltaic Module Racking Systems [CSA LTR AE-001:2012]		
Applicant	Unirac, Inc	Manufacturer 2	
Address	1411 Broadway Blvd NE Albuquerque, NM 87102	Address	
Country	USA	Country	
Contact	Klaus Nicolaedis Todd Ganshaw	Contact	
Phone	505-462-2190 505-843-1418	Phone	
FAX	NA	FAX	
Email	klaus.nicolaedis@unirac.com toddg@unirac.com	Email	
Manufacturer 3		Manufacturer 4	
Address		Address	
Country		Country	
Contact		Contact	
Phone		Phone	
FAX		FAX	
Email		Email	

2.0 Product Description	
Product	Photovoltaic Mounting System, Sun Frame Microrail Installation Guide, PUB2021JAN13
Brand name	Unirac
Description	The product covered by this report is the Sun Frame Micro Rail roof mounted Photovoltaic Rack Mounting System. This system is designed to provide bonding and grounding to photovoltaic modules. The mounting system employs anodized or mill finish aluminum brackets that are roof mounted using the slider, outlined in section 4 of this report. There are no rails within this product, whereas the 3" Micro Rail, Floating Splice, and 9" Attached Splice electrically bond the modules together forming the path to ground. The Micro Rails are installed onto the module frame by using a stainless steel bolt anodized with black oxide with a stainless type 300 bonding pin, torqued to 20 ft-lbs, retaining the modules to the bracket. The bonding pin of the Micro Rail when bolted and torqued, penetrate the anodized coating of the photovoltaic module frame (at bottom flange) to contact the metal, creating a bonded connection from module to module. The grounding of the entire system is intended to be in accordance with the latest edition of the National Electrical Code, including NEC 250: Grounding and Bonding, and NEC 690: Solar Photovoltaic Systems or the Canadian Electrical Code, CSA C22.1 Part 1 in accordance to the revision in effect in the jurisdiction in which the project resides. Any local electrical codes must be adhered in addition to the national electrical codes. The Grounding Lug is secured to the photovoltaic module, torqued in accordance with the installation manual provided in this document. Other optional grounding includes the use of the Enphase UL2703 certified grounding system, which requires a minimum of 2 micro-inverters mounted to the same rail, and using the same engage cable.

BLUE RAVEN SOLAR
1403 N. Research Way
Orem, UT 84097
800.377.4480
WWW.BLUERAVENSOLAR.COM

NABCEP CERTIFIED
PV INSTALLATION PROFESSIONAL
Scott Gurney
#PV-011719-015866

CONTRACTOR:
BRS FIELD OPS
385-498-6700

SHEET NAME:
SPEC SHEETS

REVISION: 0

PAGE NUMBER: SS

2.0 Product Description	
Models	Unirac SFM
Model Similarity	NA
Ratings	**Fuse Rating:** 30A **Module Orientation:** Portrait or Landscape **Maximum Module Size:** 17.98 ft² **UL2703 Design Load Rating:** 33 PSF Downward, 33 PSF Upward, 10 PSF Down-Slope Tested Loads - 50 psf/2400Pa Downward, 50psf/2400Pa Uplift, 15psf/720Pa Down Slope Trina TSM-255PD05.08 and Sunpower SPR-E20-327 used for Mechanical Loading Increased size ML test: **Maximum Module Size:** 22.3 ft² **UL2703 Design Load Rating:** 113 PSF Downward, 50 PSF Upward, 30 PSF Down-Slope LG355S2W-A5 used for Mechanical Loading test. **Mounting configuration:** Four mountings on each long side of panel with the longest span of 24" **UL2703 Design Load Rating:** 46.9 PSF Downward, 40 PSF Upward, 10 PSF Down-Slope LG395N2W-A5, LG360S2W-A5 and LG355S2W-A5 used for used for Mechanical Loading test. **Mounting configuration:** Six mountings for two modules used with the maximum span of 74.5" **IEC 61646 Test Loads** - 112.78 psf/5400Pa Downward, 50psf/2400Pa Uplift Fire Class Resistance Rating: - Class A for Steep Slope Applications when using Type 1 Modules. Can be installed at any interstitial gap. Installations must include Trim Rail. - Class A for Steep Slope Applications when using Type 2 Modules. Can be installed at any interstitial gap. Installations must include Trim Rail. - Class A Fire Rated for Low Slope applications with Type 1 or 2 listed photovoltaic modules. This system was evaluated with a 5" gap between the bottom of the module and the roof's surface *See section 7.0 illustractions # 1, 1a, 1aa, and 1ab for a complete list of PV modules evaluated with these racking systems*
Other Ratings	NA

7.0 Illustrations

Illustration 1- Other ratings

Manufacture	Module Model / Series
Aleo	P-Series
Astronergy	CHSM6612P, CHSM6612P/HV, CHSM6612M, CHSM6612M/HV, CHSM6610M (BL)(BF)/(HF), CHSM72M-HC
Auxin	AXN6M610T, AXN6P610T, AXN6M612T & AXN6P612T
Axitec	AXI Power, AXI Premium, AXI Black Premium
Boviet	BVM6610, BVM6612
BYD	P6K & MHK-36 Series
Canadian Solar	CS6V-M, CS6P-P, CS6K-M, CS5A-M, CS6K-MS, CS6U-P, CS6U-M, CS6X-P, CS6K-MS, CS6K-M, CS6K-P, CS6P-P, CS6P-M, CS3U-P, CS3U-MS, CS3K-P, CS3K-MS, CS1K-MS, CS3K, CS3U, CS3U-MB-AG, CS3K-MB-AG, CS6K, CS6U, CS3L, CS3W, CS1H-MS, CS1U-MS
Centrosolar America	C-Series & E-Series
CertainTeed	CT2xxMxx-01, CT2xxPxx-01, CTxxxMxx-02, CTxxxM-03, CTxxxMxx-04, CTxxxHC11-04
Dehui	DH-60M
Eco Solargy	Orion 1000 & Apollo 1000
FreeVolt	Mono PERC
GCL	GCL-P6 & GCL-M6 Series
Hansol	TD-AN3, TD-AN4, UB-AN1, UD-AN1
Heliene	36M, 60M, 60P, 72M & 72P Series
HT Solar	HT60-156(M) (NDV) (-F), HT 72-156(M/P)
Hyundai	KG, MG, TG, RI, RG, TI, MI, HI & KI Series
ITEK	iT, iT-HE & iT-SE Series
Japan Solar	JPS-60 & JPS-72 Series

BLUE RAVEN SOLAR
1403 N. Research Way
Orem, UT 84097
800.377.4480
WWW.BLUERAVENSOLAR.COM

NABCEP CERTIFIED
PV INSTALLATION PROFESSIONAL
Scott Gurney
#PV-011719-015866

CONTRACTOR:
BRS FIELD OPS
385-498-6700

SHEET NAME:
SPEC SHEETS

REVISION: 0

PAGE NUMBER: SS

7.0 Illustrations

Illustration 1a - Other Ratings Continue

Manufacture	Module Model / Series
JA Solar	JAP6 60-xxx, JAM6-60-xxx/SI, JAM6(K)-60/xxx, JAP6(k)-72-xxx/4BB, JAP72SYY-xxx/ZZ, JAP6(k)-60-xxx/4BB, JAP60SYY-xxx/ZZ, JAM6(k)-72-xxx/ZZ, JAM72SYY-xxx/ZZ, JAM6(k)-60-xxx/ZZ, JAM60SYY-xxx/ZZ. i. YY: 01, 02, 03, 09, 10 ii. ZZ: SC, PR, BP, HiT, IB, MW
Jinko	JKM & JKMS Series
Kyocera	KU Series
LG Electronics	LG xxx S1C-A5, LG xxx N1C-A5, LGxxxQ1C(Q1K)-A5, LGxxxN1C(N1K)-A5, LGxxxS1CA5, LGxxxA1C-A5, LGxxxN2T-A4, LGxxxN2T-A5, LGxxxN2W-A5 LGxxxS2W-A5, LGxxxE1C-A5, LGxxxS2W-G4 LGxxxN1C(N1K)-G4, LGxxxN2W-G4, LGxxxS1C-G4, LGxxxE1K-A5, LGxxxN2T-J5, LGxxxN1K(N1C)-V5, LGxxxQ1C(N2W)-V5,
LONGi	LR6-60 & LR6-72 Series, LR4-60 & LR4-72 Series
Mission Solar Energy	MSE Series
Mitsubishi	MJE & MLE Series
Neo Solar Power Co.	D6M & D6P Series
Panasonic	VBHNxxxSA15 & SA16, VBHNxxxSA17 & SA18, VBHNxxxSA17(E/G) & SA18E, VBHNxxxKA01 & KA03 & KA04, VBHNxxxZA01, VBHNxxxZA02, VBHNxxxZA03, VBHNxxxZA04
Peimar	SGxxxM (FB/BF)
Phono Solar	PS-60, PS-72
Q.Cells	Plus, Pro, Peak, G3, G4, G5, G6(+), G7, G8(+) Pro, Peak L-G2, L-G4, L-G5, L-G6, L-G7

7.0 Illustrations

Illustration 1aa - Other Ratings Continue

Manufacture	Module Model / Series
REC	PEAK Energy Series, PEAK Energy BLK2 Series, PEAK Energy 72 Series, TwinPeak 2 Series, TwinPeak 2 BLK2 Series, TwinPeak Series
Renesola	Vitrus2 Series & 156 Series
Risen	RSM Series
S-Energy	SN72 & SN60 Series (40mm)
Seraphim	SEG-6 & SRP-6 Series
Sharp	NU-SA & NU-SC Series
Silfab	SLA, SLG & BC Series
Solaria	PowerXT
SolarWorld	Sunmodule Protect, Sunmodule Plus
Sonali	SS 230 - 265
Suntech	STP
Suniva	MV Series & Optimus Series
Sun Edison/Flextronics	F-Series, R-Series & FLEX FXS Series
SunPower	X-Series, E-Series & P-Series
Talesun	TP572, TP596, TP654, TP660, TP672, Hipor M, Smart
Tesla	SC, SC B, SC B1, SC B2
Trina	PA05, PD05, DD05, DE06, DD06, PE06, PD14, PE14, DD14, DE14, DE15, PE15H
Upsolar	UP-MxxxP(-B), UP-MxxxM(-B)
URE	D7MxxxH8A, D7KxxxH8A, D7MxxxH7A
Vikram	Eldora, Solivo, Somera
Waaree	AC & Adiya Series
Winaico	WST & WSP Series
Yingli	YGE & YLM Series

BLUE RAVEN SOLAR
1403 N. Research Way
Orem, UT 84097
800.377.4480
WWW.BLUERAVENSOLAR.COM

NABCEP CERTIFIED
PV INSTALLATION PROFESSIONAL
Scott Gurney
#PV-011719-015866

CONTRACTOR:
BRS FIELD OPS
385-498-6700

SHEET NAME:
SPEC SHEETS

REVISION: 0

PAGE NUMBER: SS

From: Deep Vora Intertek
To: Klaus Nicolaedis
Cc: Robert Danastasio; Sam Doshi Intertek
Subject: RE: Unirac SFM module listing
Date: Tuesday, July 27, 2021 6:31:09 PM
Attachments: image003.png
image004.png
image005.png

Hello Klaus,
I can confirm that through your last UL 2703 report update for your Sun Frame Micro Rail PV Mounting System in May 2021, Intertek added the following list of solar module frames for REC PV module manufacturer after evaluation and frame profile comparison.

REC Alpha 72 is one of these added modules.

Please let me know if you need any other information.

REC Solar	Twin Peak 2SM 72	Yes	Twin Peak Series	Manufacturer Similarity Email, and profile Comparison	NA	Approved
	Alpha Black	Yes			NA	Approved
	Alpha	Yes			NA	Approved
	Alpha 72	Yes			NA	Approved
	REC Twin Peak 2S 72	Yes			NA	Approved
	Twin Peak 2S 72 XV	Yes			NA	Approved
	Twin Peak 2SM 72 XV	Yes			NA	Approved
	N-Peak	Yes			NA	Approved
	N-Peak Black	Yes			NA	Approved

Sunny regards,
Deep Vora
Photovoltaic Project Engineer

intertek
Total Quality. Assured.
25800 Commercentre Drive
Lake Forest, CA 92630
Email: deep.vora@intertek.com
Mobile: +1 (480) 738 9760
Office: +1 (949) 393 3522 Ext: 11756805

From: Klaus Nicolaedis <Klaus.Nicolaedis@unirac.com>
Sent: Monday, July 26, 2021 7:08 AM
To: Deep Vora Intertek <deep.vora@intertek.com>
Cc: Robert Danastasio <robert.danastasio@unirac.com>
Subject: [External] Unirac SFM module listing

Hi Deep,

We have an AHJ questioning if the REC Alpha 72 is approved because of how we list the REC modules in the IM.

REC	Alpha (72) (Black) N-Peak (Black) PEAK Energy Series PEAK Energy BLK2 Series PEAK Energy 72 Series TwinPeak Series TwinPeak 2 Series TwinPeak 2 BLK2 Series TwinPeak 2S(M)72(XV) TwinPeak 3 Series (38mm)

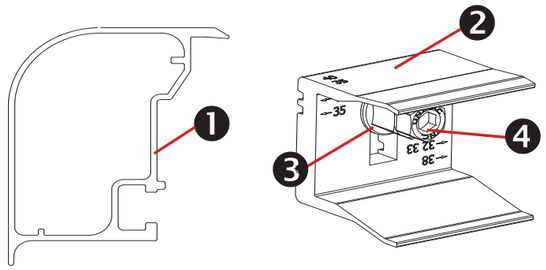
Can you send us an email with your signature block stating that the following modules are approved with SFM?

Alpha
Alpha 72
Alpha Black

Kind regards,

1411 Broadway Blvd. NE, Albuquerque NM - 87102

Klaus Nicolaedis
CERTIFICATION ENGINEER
Unirac, Inc.
klaus.nicolaedis@unirac.com
direct 505.462.2190



Trimrail™ and Module Clips

Sub-Components:
1. Trim Rail
2. Module Clip
3. T-Bolt
4. Tri-Drive Nut

Trimrail™

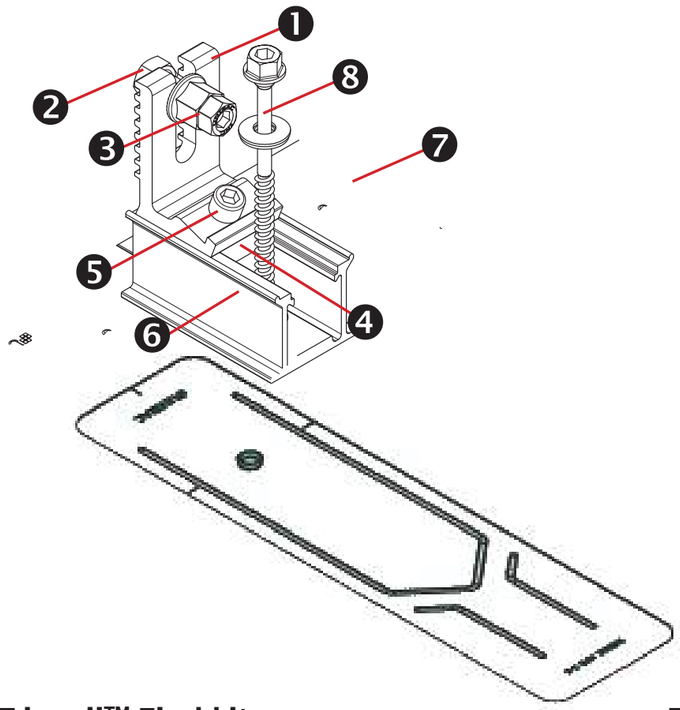
Functions:
- Required front row structural support (with module clips)
- Module mounting
- Installation aid
- Aesthetic trim

Features:
- Mounts directly to L-feet
- Aligns and captures module leading edge
  - Supports discrete module thicknesses from 32, 33, 35, 38, and 40mm

Module Clips

Functions:
- Required front row structural support (with trimrail)
- Module mounting

Features:
- Mounts to Trimrail™ with T-bolt and tri-drive nut
- Manually adjustable to fit module thicknesses 32, 33, 35, 38, and 40mm.

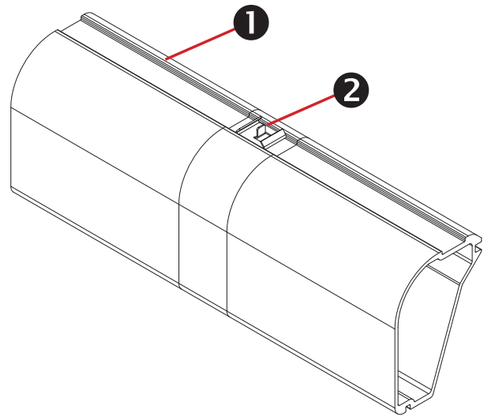


Trimrail™ Flashkit

Sub-Components:
L-Foot
Hex bolt
Tri-drive nut
Channel Nut
Scocket Head Cap Screw
3"Channel/Slider w/grommet
3" Wide Flashing
Structural Screw & SS EPDM Washer

Functions:
- Attach Trimrail™ to roof attachment / flashing
- Patented roof sealing technology at roof attachment point

Features:
- Slot provides vertical adjustments to level array
- Slider provides north/south adjustment along the slope of the roof
- Shed and Seal Technology



Trimrail™ Splice

Sub-Components:
1. Structural Splice Extrusion
2. Bonding Clip

Functions:
- Front row structural support
- Installation aid
- Structurally connects 2 pieces of Trimrail™
- Electrically bonds 2 pieces of Trimrail™

Features:
- Aligns and connects Trimrail™ pieces
- Tool-less installation

BLUE RAVEN SOLAR

1403 N RESEARCH WAY, BUILDING J
OREM, UT 84097

800-377-4480
WWW.BLUERAVENSOLAR.COM

NABCEP CERTIFIED
PV INSTALLATION PROFESSIONAL
Scott Gurney
PV-011719-015866

CONTRACTOR:
BRS FIELD OPS
385.498.6700

SHEET NAME
SPEC SHEET

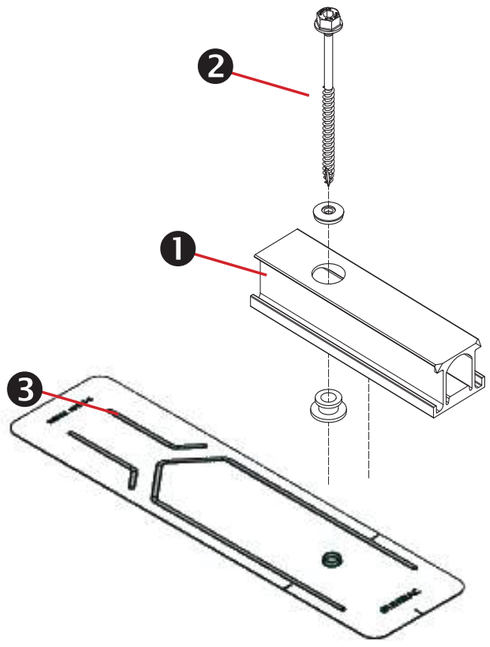
PAGE NUMBER
SS

REVISION
0

SFM SUN FRAME MICRORAIL™

SYSTEM COMPONENTS
INSTALLATION GUIDE

D PAGE

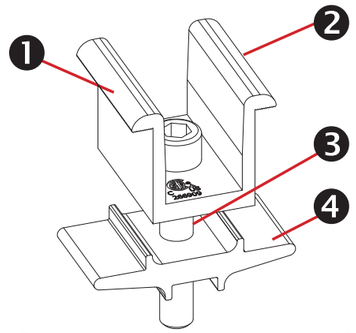


SFM Slider Flashkit

Sub-Components:
1. Slider w/grommet
2. Structural Screw & SS EPDM washer
3. 3" Wide Flashing

Functions:
- Patented Shed & Seal roof sealing technology at roof attachment point
- For use with compatible 2" Microrail or 8" Attached Splices

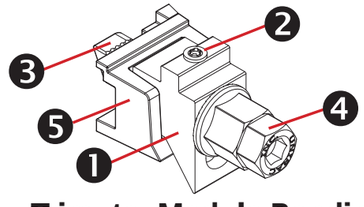
Features:
- Slider provides north/south adjustment along the slope of the roof
- Shed and Seal Technology



Module-to-Module N-S Bonding

Sub-Components:
1. Clamp
2. Bonding Pins (2)
3. 5/16" Socket Head Cap Screw
4. Clamp Base

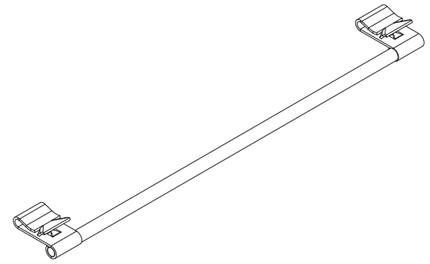
Functions/ Features:
- Row to row bonding
- Single Use Only
- Fits module sizes 32-40mm



Trim -to- Module Bonding Clamp and Floating Trim Clamp

Sub-Components:
1. Wedge
2. Bonding Pin
3. T-Bolt
4. Nut
5. Cast Base

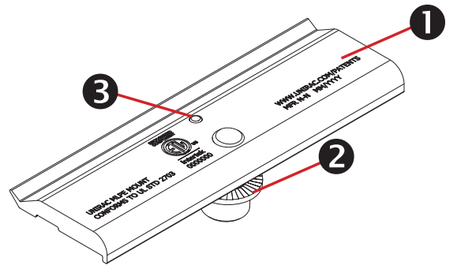
Functions/ Features:
- Module to Trimrail™ bonding - single use only
- Attaches Trimrail™ to module when fewer than 2 rafter attachment points are available
- Fits module sizes 32-40mm
- Fits module sizes 32-40mm



Wire Bonding Clip w/ 8AWG

Functions:
- Row to row bonding
- Module to Trimrail™ bonding
- Single Use Only

Features:
Tool-less installation



MLPE Mounting Assembly

Sub-Components:
1. MLPE Mount Base
2. 5/16 Socket Head Cap Screw
3. Bonding Pin

Functions:
- Securely mounts MLPE to module frames
- MLPE to module bonding

Features:
- Mounts easily to typical module flange
- UL2703 Recognized

MLPE = Module Level Power Electronics, e.g. microinverter or power optimizer

BLUE RAVEN SOLAR

1403 N RESEARCH WAY, BUILDING J
OREM, UT 84097

800-377-4480
WWW.BLUERAVENSOLAR.COM

NABCEP CERTIFIED
PV INSTALLATION PROFESSIONAL
Scott Gurney
PV-011719-015866

CONTRACTOR:
BRS FIELD OPS
385.498.6700

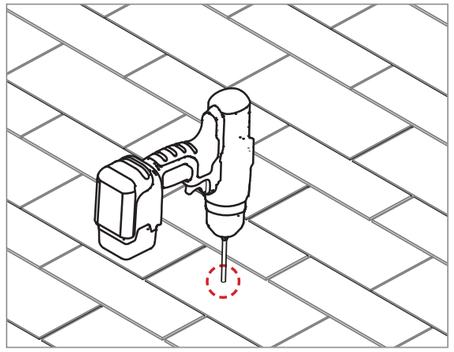
SHEET NAME
SPEC SHEET

PAGE NUMBER	REVISION
SS	0

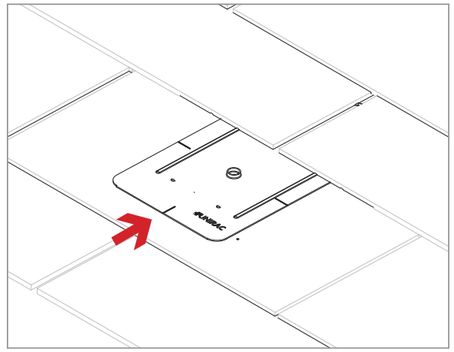
SFM SUN FRAME MICRORAIL™

3" FLASHING & SLIDERS INSTALLATION GUIDE

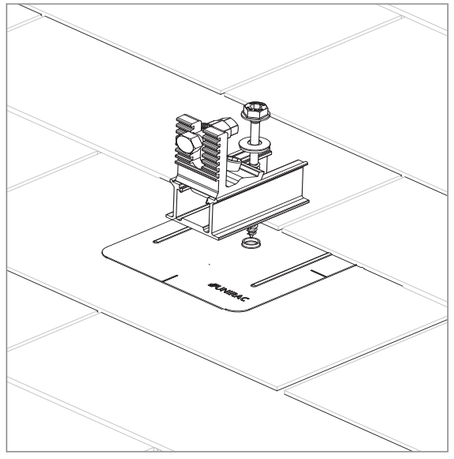
G PAGE

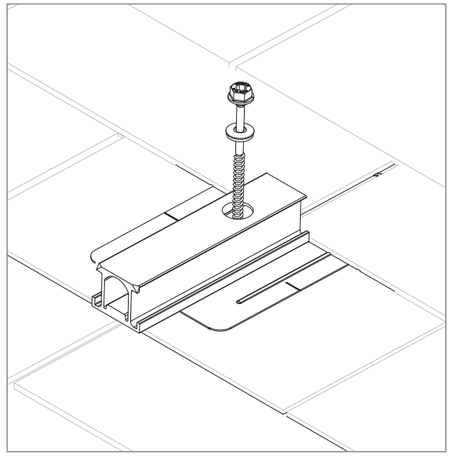


PILOT HOLES:
Drill pilot holes for lag screws or structural screws (as necessary) at marked attachement points



FLASHINGS:
Place flashings





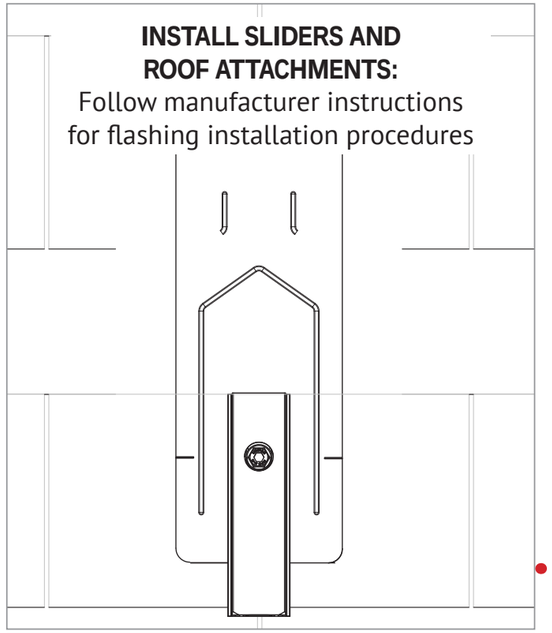
INSTALL SLIDERS AND TRIMRAIL ROOF ATTACHMENTS:

- Insert flashings per manufacturer instructions

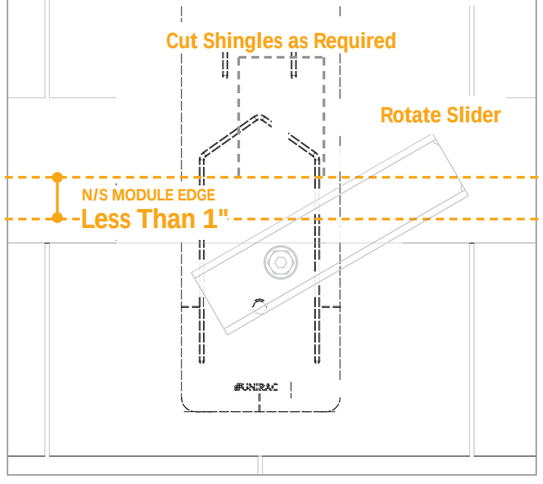
NOTE: Use Lag screw or structural fastener with a maximum diameter of 5/16"

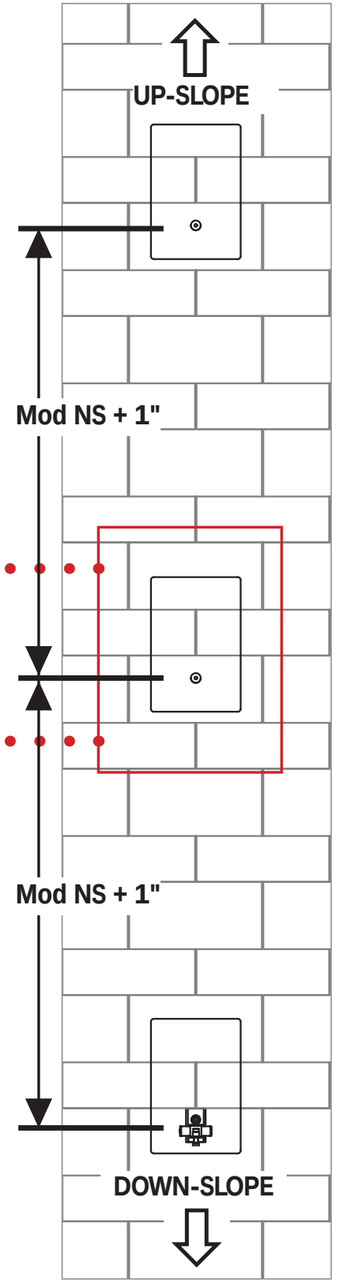
- Attach sliders to rafters
- Verify proper row to row spacing for module size (Mod NS + 1")
- Ensure that TrimrailTM roof attachments in each row have sufficient engagement with slider dovetails for proper attachment.

INSTALL SLIDERS AND ROOF ATTACHMENTS:
Follow manufacturer instructions for flashing installation procedures



NOTE: If N-S module edge is within 1" of the shingle course above, you have the option to pivot / rotate slider at the attachment point to span the next course and cut shingles as required.





BLUE RAVEN SOLAR

1403 N RESEARCH WAY, BUILDING J
OREM, UT 84097

800-377-4480
WWW.BLUERAVENSOLAR.COM

NABCEP CERTIFIED
PV INSTALLATION PROFESSIONAL
Scott Gurney
PV-011719-015866

CONTRACTOR:
BRS FIELD OPS
385.498.6700

SHEET NAME
SPEC SHEET

PAGE NUMBER
SS

REVISION
0